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KEY ELEMENTS OF A NATIONAL ENERGY POLICY

HEARING

BEFORE THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE

ONE HUNDRED FIRST CONGRESS

SECOND SESSION

ON THE

KEY ELEMENTS OF A NATIONAL ENERGY POLICY THAT CAN EFFECTIVELY ADDRESS U.S. PETROLEUM DEPENDENCE

OCTOBER 2, 1990

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KEY ELEMENTS OF A NATIONAL ENERGY POLICY

TUESDAY, OCTOBER 2, 1990

U.S. Senate,
Committee on Energy and Natural Resources,
Washington, DC.

The committee met, pursuant to notice, at 9:30 a.m. in room SD-366, Dirksen Senate Office Building, Hon. Jeff Bingaman, presiding.

OPENING STATEMENT OF HON. JEFF BINGAMAN, U.S. SENATOR FROM NEW MEXICO

Senator Bingaman. The hearing will come to order.

This is a hearing of the Senate Energy and Natural Resources Committee. The purpose of the hearing today is to receive testimony on what should be the key elements of a national energy policy that can address the Nation's dependence on imported oil.

A little over 2 weeks ago our committee received testimony from the Secretary and the Deputy Secretary of Energy concerning the implications of the Persian Gulf crisis for oil supply in the near term and what they referred to as the midterm.

At that hearing, Secretary Watkins unveiled what he referred to as the administration's medium-term energy measures. With respect to the national energy strategy, however, the Department testified that it would stick to its pre-crisis schedule. That schedule calls for the Department of Energy to present the President with options for a national energy strategy in December of this year, and the strategy itself is not scheduled to be presented to the Congress before April of next year.

I told Henson Moore at that hearing that the administration should try to catch the wave and move ahead with a strategy while there was some sense of immediacy or urgency attached to these energy issues, and I suggested the President ought to present the Congress with the legislation to implement a national energy strategy as part of his State of the Union address in January. I hope that that suggestion is taken to heart. I hope we can, in fact, see the administration's proposals in this area before April of next year.

Even members of the President's own party are chomping at the bit to get on with at least some aspects of an energy policy. Last week, the Republican members of the House Energy and Commerce Committee announced the outline that they had prepared for a Comprehensive Energy Self-Sufficiency Act. Not even they seem willing to wait another 6 months for the unveiling of an administration plan.

Today's hearing is a follow-up to the committee's September 13 hearing. The purpose of the hearing today is to identify options for addressing the Nation's crippling addiction to imported oil.

During the first 8.5 months of 1990 the United States imported over 45 percent of the crude oil and refined product that were supplied here for domestic use. On average, imports total over 7.8 million barrels per day.

In 1987 when the United States imported only 5.9 million barrels per day, the tab for oil imports accounted for one-third of the Nation's trade deficit. That was in a year when crude oil prices averaged $16.50 per barrel. I think we are all well aware of the impact that this increased price of oil is going to have on the trade deficit for this year and perhaps future years.

This is more than just a hearing about oil. It is also a hearing about alternatives to oil, for, clearly, the price and availability of oil in large part dictates the viability of alternative fuels in conservation. As one member of the committee put it at the September 13 hearing, the price of oil is the gold standard by which the value of other energy commodities is measured. Consequently, any examination of energy policy options must have as its starting point oil and oil import dependence.

The committee has invited a panel of four recognized energy experts to share with us their views on these questions.

Before we begin with the panel, let me call on my colleague, Senator Ford, for any opening statement he would like to make at this time.

STATEMENT OF HON. WENDELL FORD, U.S. SENATOR FROM KENTUCKY

Senator FORD. Thank you, Mr. Chairman. This is kind of revisiting something that I visited at the beginning of 1976. It is ironic that people now are saying about the same thing today that they were saying back then.

The committee is holding this hearing to seek advice now in the decade of the 1990's on the development of a national energy policy. There will undoubtedly be more hearings to follow. This is only a beginning. The development of a national energy policy for the 1990's will be one of our biggest jobs, in my opinion, in the next Congress.

We have excellent witnesses today. I am very pleased that the four of you have agreed to come and chat with us today.

Now I understand the ground rule for the hearing this morning is to encourage plain speaking, just lay it out, not be bashful about it, do not try to be coy or use words that might not sound too bad. Just speak in four-letter words, and I particularly will understand it a lot better. This is an opportunity to give our committee the benefit of your experience with energy issues. We want your advice as to how we should go in developing what we hope finally will be a real national energy policy.

This committee bears much of the load in energy policy in the Senate. It is our experience that energy issues bring out some of the toughest—and I underscore "toughest"—political choices that exist. Region is pitted against region, industry against industry. There are complex international problems that must be mixed with a complex domestic impact. There are strong popular prejudices that clash with economics. How you vote on these issues usually has little to do with your political party affiliation.

You will need to recognize some of these practical factors in devising an energy policy, but do not let the difficulties of the politics of energy defeat your good judgment. The politics of energy is our problem to worry about. What we need from you this morning is your best advice about what should be done for the good of the country—and I underscore the good of the country. That is why we have asked you here today.

We have had an energy policy now for about 10 years, and that is dependency on someone else. I was somewhat disappointed but it was not unexpected, when the House Republicans came forward with their energy policy and asked the Democrats where is yours. Well, President Nixon had an attempt at it and tried, President Ford tried, and President Carter tried. And they are the ones who cut the energy policy off at the knees. It was the moral equivalent to war. Now we are practically in a real war. If they were selling apples and oranges, it is my opinion we would not even be close to the Persian Gulf.

So, Mr. Chairman, I appreciate the opportunity this morning, and I will have some questions for the witnesses. I think we all want to arrive at the same place, and hopefully the energy strategy can come together sooner rather than later.

Senator BINGAMAN. Thank you very much.

Senator Akaka, did you have an opening statement?

STATEMENT OF HON. DANIEL K. AKAKA, U.S. SENATOR FROM HAWAII

Senator AKAKA. Thank you very much, Mr. Chairman. I wanted to thank you for scheduling this hearing, and I also want to welcome our distinguished energy experts. If ever there was an issue, Mr. Chairman, that cries out for expert advice, that issue is our energy problem.

Concern about America's energy future is not new to me. Throughout my 14-year career in the House I fought an often lonely battle to halt the Federal Government's dwindling commitment to renewable energy. The only positive thing I can say about the current energy crisis is that it will force the Federal Government to wake up to the need for renewable energy resources that we have long neglected.

This is not the first time our country has faced a dramatic spike in energy prices because of the events in the Middle East, nor is it the second. We are entering the third significant economic disruption due to the absence of any coherent long-range plan for a more secure energy future.

We now recognize that low energy prices in recent years have only been a wolf in sheep's clothing, lulling Americans into complacency about their energy security.

Iraq's invasion and the surging oil prices that have resulted make it imperative that we develop and implement a national energy strategy.

Today I am introducing, Mr. Chairman, legislation requiring the President to convene a national energy summit. Last year we had an education summit. This year we have had a budget summit.

In light of our current energy problems, I call on the President to convene a summit on energy. Our energy problems as just as much a threat to our economy as our budget woes.

The people of Hawaii understand the urgent need to address our energy problems. We read about it on an almost daily basis. Yesterday's headline comes across loud and clear and here is the headline: Your Electric Bill is Going to Soar by 33 Percent.

An energy summit would permit Congress and the President to chart a road map for America's future energy security. We would set goals for energy efficiency and consumption and we would commit ourselves to energy technologies that offer hope of greater independence from certain foreign supplies.

An energy summit is the only answer, but it certainly can be a part of the solution. I am sure that you will have other suggestions that may be equally sufficient.

I thank you very much, Mr. Chairman, for the opportunity to make this statement.

Senator BINGAMAN. Thank you very much, Senator Akaka.

Senator Burns, did you have an opening statement?

Senator BURNS. I have no opening statement. We have all this brain power here this morning, and I have come to hear what they have say.

Senator BINGAMAN. All right.

Senator Wirth.

STATEMENT OF HON. TIMOTHY E. WIRTH, U.S. SENATOR FROM COLORADO

Senator WIRTH. Thank you, Mr. Chairman. I am delighted to have this distinguished panel here. Mr. Gibbons, I want to just first of all applaud you on the recent OTA study on replacing gasoline, which I thought made a great deal of sense and I hope we have a chance to talk about that morning.

The Straits of Hormuz, as we know, Mr. Chairman, are just as narrow today as they were 10 years ago and 20 years ago and 30 years ago and that will be the same 10 years from now and 20 years from now and 30 years from now.

Unhappily, the present administration seems to believe that the way for us to approach this is to get out tire gauges and make sure that we have the right pressure in our tires. It reminds me a little bit of a previous Secretary who told us that the cure for the ozone problem was to wear dark glasses and hats and so on, and suntan lotion, I believe.

I hope that we do get a feeling of some sense of urgency and some understanding that our national security is now dramatically being redefined. The timing of this hearing is really very coincidental and I think reminds us of the fact that the world has changed. As Germany unites only today, our national security has gone from one of confrontation of the Soviet Union to one of understanding that our national security is defined by environmental issues, population issues, energy issues, and we have to think a lot more differently.

There is nothing, I do not think, maybe we will discover some great new ideas today, but I suspect we will hear exactly what I have heard from every member of this panel before, that we ought to be encouraging energy conservation; that transportation uses two-thirds of our oil, so therefore our transportation sector ought to be more efficient; that we ought to be encouraging domestic fuels, particularly natural gas; that we ought to have a realistic pricing policy that encourages conservation and encourages us to move toward alternative programs, that we are going to have to bite the political bullet and do some research on nuclear, to see if that is going to pay off down the line. We do not know if it will or not.

There is not much new about all of this, I would suspect, and it is a matter of garnering the political will to take it on. I am greatly appreciative of having this panel here and maybe we will increase the level of debate and we will go beyond tire pumps and tire pressure gauges and think about the long-term issues that we have to understand, undertake and that will really put together a better understanding of energy as it relates to the economy and the environment.

Thank you very much, Mr. Chairman. I am very pleased that you urged Chairman Johnston to do this and we greatly appreciate all of you for being here and look forward to hearing from you.

Senator BINGAMAN. Thank you very much. Senator McClure, did you have a statement?

Senator MCCLURE. I would ask that it be put in the record.

Senator BINGAMAN. It will be included in the record in full.

[The prepared statement of Senator McClure follows:]

PREPARED STATEMENT OF HON. JAMES A. MCCLURE, U.S. SENATOR FROM IDAHO

I want to commend Senator Johnston for holding this oversight hearing on the policy implications of the oil situation, and the necessary elements of a national energy policy.

While no commodity is more essential to a modern society than energy, it is largely taken for granted—that is until we are told that we have to do with less or that we must pay higher prices.

Although it is too early to determine the full impact of the current supply disruption—in part because we do not know how serious the situation may get—it is already having significant economic, military and geopolitical consequences.

In the short-run, if the lost Iraq/Kuwait production is not made up by increased production elsewhere, oil prices will remain high. And prices may remain high even if it is made up because of the current market psychology. While that would be harmful to consumers and damaging to our economy, the longer-term Implications of our energy situation are even more significant.

We should view what has happened in the oil market since the August 2 invasion by Iraq like the recent California earthquake: it is just a warning. The BIG ONE has yet to come. Keep in mind that the Middle East countries account for 38 percent of the free world's oil supplies. Right now there is no physical shortage of oil, but if Iraq invades Saudi Arabia there would be one that would dwarf what we have seen so far, including the 1973 Arab oil embargo.

Without comprehensive action to address our energy problems, not only with respect to oil and natural gas, but also nuclear and coal power, our future situation can be boiled down to one basic fact: foreign dependency. Our energy supplies will increasingly be controlled by foreign producers who place their interests first, not ours.

Now some believe that it is all right to shut-down operable nuclear powerplants and even oppose research and development into passively safe nuclear power technology; others believe that it is OK to impose onshore and offshore leasing and production moratoria and import replacement supplies; and still others are comfortable imposing new clean air requirements which not only constrain future energy development, but also may well result in the closure of existing facilities, refineries in particular.

In this Senator's mind it is only too obvious that these views are short-sighted and not in our Nation's long-term interests.

In closing let me say that there is one thing that is important for us not to do: that is to use the Strategic Petroleum Reserve to manipulate the price of oil. The Reserve must be preserved for the purposes for which it was originally created, that of responding to international disruptions of oil supplies.

The Reserve was established to offset physical shortages of oil, not to respond to consumer complaints about prices, and the law is quite clear on this point. Moreover, using the Reserve at this time to dampen prices could unintentionally result in its not being there when we actually need it.

I look forward to the views of today's witnesses about the situation and what ought to be in a long-term national energy policy.

Senator BINGAMAN. Let us go ahead with our witnesses. The first witness is Dr. Daniel Yergin, who is an internationally recognized expert on energy issues. He is the President of Cambridge Energy Research Associates in Cambridge, Massachusetts, and formerly a professor at the Kennedy School of Government and the Harvard Business School.

Dr. Yergin, why do you not go right ahead. I would just urge that all witnesses take 10 minutes or so and summarize their statements and then we will include in the record any written statements that they have or any other items they would like to include in the record.

Dr. Yergin.

STATEMENT OF DR. DANIEL YERGIN, PRESIDENT, CAMBRIDGE ENERGY RESEARCH ASSOCIATES, CAMBRIDGE, MA

Dr. YERGIN. Thank you. Mr. Chairman and members of the committee. I am very pleased to have this invitation to appear before the committee and also pleased to be part of this expert panel.

It seems to me that this hearing is really picking up where a hearing I participated in last March 26 in this room left off. At that point this hearing room was pretty sparsely attended, and yet the record of that hearing, as we look back, makes very dramatic and striking reading in terms of the context of where things stand today.

At the time, Senator Johnston said that it is time we sound the klaxon, no one heard it then, and Senator Domenici said that although nobody is very concerned, sometime we will be back in this room when oil is a crisis and the hearing room will be filled. And having looked around before, it looks to me like this hearing room is pretty crowded today.

Responding to the committee's gracious invitation, I would like to offer a few thoughts about where we are and how we might proceed. Let me explain the context for my remarks. I have just come to the end of a long, really a too long, research project that centers on the relationship among oil, politics, economy, and our way of life.

In the time available to me this morning I would like to respond to the topic of this hearing and draw on some of the things that I learned in the course of this work that are relevant and put forward what might be a few guideposts for thinking about the future.

First, a simple question, how did we go from $15 to $35 to $40 so suddenly? I think that question takes us back to the hearings last March and the trends that formed the basis of the discussion then and are the trends that are shaping today's situation.

The oil market was tightening rather rapidly, our imports were going up, the market was tightening because of the fall in U.S. production, the strong demand for oil, particularly in the Far East, and growing problems in Soviet oil production.

Spare capacity, which is the key concept in terms of stability in the world oil market, had declined from 10 million barrels a day in the middle of the 1980's to around 4 million barrels per day by the middle of this year.

Dependence on the Middle East was rising rapidly and the question of the timing of capacity additions was moving to the fore. This meant very simply that the world oil market was becoming increasingly accident prone or crisis prone and yet for the most part, these trends were ignored or waved away with the refrain that oil would always be available.

Well, a few years ago the world oil market could have lost 4 million barrels a day with no difficulty and made up that loss. Today, with the loss of Iraq and Kuwait, we are scrimping by. We are barely scrimping by and there is essentially no give at all in the system. There is no spare capacity and, indeed, apparently not quite enough capacity to meet demand.

The high prices we see today reflect two components: one is the significant disruption in supplies, the tautness in the market, the problem of crude quality, logistical disruption, and I think that logistical disruption is something that needs more emphasis. This disruption is on the same scale as 1973 and 1979.

But the other component is simple anxiety and fear. We will see the oil price rise and fall on fears and expectation of military conflict at any given time. The blunt fact is that today, in addition to retrostream market conditions, the oil price has become a thermometer that measures war fever.

Will oil prices go higher? There are forces that will work against that: the apparent recession, the conservation response, the existence of inventories and, of course, the existence of the strategic petroleum reserve.

What could push prices up? The weather, unexpected accidents, or bottlenecks in oil production and refining anywhere in the world and conflict in the Middle East.

Looking back on the 1970's, we can see the stresses that this type of situation puts on our political system. Sharply rising energy prices hit the public hard, particularly lower income groups, and the Kuwait crisis was neither in anybody's GNP projections nor in anybody's family budget.

There is an inevitable cry to do something, and that tends to get us off in domestic political controversies that miss the point that there is a real and genuine disruption in the world. With a little time, the global logistical system and supply system can adapt. I hope that this crisis does not develop into an extended affair. If it does, I certainly hope that we as a country can keep our eye on the ball and the main issues.

Short-term expedients like price controls and allocations end up imposing a long-term cost on the Nation and impede the adjustment. Many of you will remember the irony of the gas line shortages in the cities and areas of population growth, with gasoline to spare in resort areas to which no one could get. Our allocation that we have used in the past really led to rationing by gas lines.

The crisis once again demonstrates the importance of a coordinated international response among the industrial nations through the mechanism of the International Energy Agency. There is only one oil market, and all buyers are affected. The IEA helps to modulate the rivalries, suspicions, and fears which in general fuel panic and, in this case, would undercut the remarkable international consensus that the administration has forged.

I think it is important to keep in mind that there are many suspicions that we do not hear and see in the United States. We tend to underestimate them. We do not appreciate the way that the United States is seen as the behemoth in the world oil market, the Saudi Arabia of oil consumption.

Where do we go from here? Clearly, energy and oil are at the heart of this conflict and a situation in which we depend on an increasingly taut world oil market holds unacceptable costs.

Two directions are pretty clear as to ways in which we ought to move. One is to increase the use of North American natural gas and to move away the impediments to its use. The other is a renewed commitment to conservation. It is noteworthy that both of these were already being propelled forward by environmental considerations.

A difference from the 1970's is that today, by contrast, there is a wide recognition that conservation has a very important contribution to make to our economic well-being and our security. The argument ahead and the argument with which I think that this committee will be dealing over the next couple of years is how to achieve it, whether you do it by urging it, by pricing it, by taxing it or by regulating it. I imagine that there will be a good deal of discussion on that in this room in the future.

Rapid growth in U.S. oil imports is not only expensive for this country but destabilizing for the world market. We have to address the question of the U.S. production decline and what can be done about it, what can be done to slow it. It is something that has been remarkably ignored. U.S. crude and condensate production has fallen by 1.6 million barrels since 1986, and we would expect another 1.5 million-barrel decline by the year 2000.

Looking back, we can see that the United States rather wantonly let a lot of oil production evaporate that is not recoverable. The production loss might have been mitigated, but that is history. The loss of that production turns out to be a heavy cost for the whole Nation, as every motorist is finding and as we see recession stalking the economy.

It is important that we look again at the energy research and development questions. I would think that Dr. Gibbons will go into that more, and so I will not pursue that right now.

The north-south struggles in the 1970's seem to be behind us for the most part, and I think that gives us an opportunity. With the sovereignty issue firmly resolved by the oil-producing nations, the possibility exists for more creative relationships between the United States and the various oil-producing countries which would meet these nations' objectives and also encourage energy production. That is certainly the case here in this hemisphere with Venezuela and Mexico.

Two more points. In the 1970's, the biggest source of contention in the domestic energy arena I think as we look back was the economic clash, producers versus consumers, markets versus regulations. From the vantage point of today, the central clash in the 1990's looks to be different between environmental and supply considerations.

How do we find the balance between these legitimate and competing concerns? The reality is that the environmental consensus has broad support and has become an integral part of our political process and our national culture. Yet, it is no less true that the production and consumption of energy are intimately linked to our economic well-being and our security and strength as a country.

Will the conflicts between these two sets of concerns be resolved only on a case-by-case basis, issue by issue, the outcome depending on the constellation of forces at any given time, or can we find some form of mediation? I do not see a clear answer at this time, but that question will provide the context in which so many energy issues will be fought out, and it behooves all of us to apply ourselves to the critical question of the framework for approaching them.

I know others will address the question of motor fuel and transportation, so let me conclude with one final point. It is a lesson that Winston Churchill enunciated some 77 years ago when he was leading the effort to convert the British Navy to oil. Britain did not produce oil, as Churchill knew so well, only Welsh coal, and that meant it was going to be dependent on imports. His answer to the security problem posed therein was diversification.

He said, "On no one quality, on no one process, on no one country, on no one route, and on no one field must we be dependent. Safety and certainty in oil lie in variety and variety alone."

The case for diversification of options was overwhelming at the beginning of the 20th century. The Kuwait crisis reminds us that it is no less applicable at the end of the 20th century. What was wisdom for Winston Churchill in 1913 is wisdom for America in the 1990's.

Thank you.

[The prepared statement of Dr. Yergin follows:]

PREPARED STATEMENT OF DR. DANIEL YERGIN, PRESIDENT, CAMBRIDGE ENERGY RESEARCH ASSOCIATES, CAMBRIDGE, MA

I very much appreciate the invitation to appear before the Senate Energy Committee at this critical moment. It seems that the Committee is really picking up where it left off in its hearings on "World Oil Outlook" last March 2, 1990. The hearing room then was rather sparsely attended. And yet the record of that hearing makes striking reading in the context of where things stand today. In that hearing, the chairman, Senator Johnston, expressed his concerns about the trends in world oil and the potential effects on the "economy of the United States." It is time, he said, "that we sound the klaxon." Unfortunately, the klaxon was not well heard. And I vividly remember Senator Domenici's prediction that, despite the fact that "nobody seems very concerned," nevertheless, "we will be back in this room" when oil is a crisis and the hearing room will be filled, for "the second most serious crisis for the United States, without any question, is our continued growing dependence upon foreign oil." [1] None of us were privy to Saddam Hussein's thoughts and thus did not know we would be back so quickly. Yet here we are back in this hearing room, not two or three years hence, as we might have thought, but a mere seven months.

Responding to the committee's gracious invitation, I would like to offer a few thoughts about where we are and how we might proceed. Let me explain the context for my remarks. I have just come to the end of a long research project that centers on the relationship among oil, and politics, and our economy, and our way of life. It is entitled, perhaps ironically, "The Prize." In the time available this morning to respond to the topic of this hearing, I would like to draw on some of the things that I have learned in the course of this project that are relevant and put forward what might be suggested as guideposts for the future.

(1) First, how did we go from $15 to $35-40 oil so suddenly? That question takes us back to those hearings last March and the trends that formed the basis of the discussion then. The world oil market was tightening rather rapidly, because of the fall in U.S. oil production, strong demand for oil particularly in the Far East, and the problems in Soviet oil production. Spare capacity—which is the key concept—had declined from 10 million barrels per day in the middle 1980s to around 4 million barrels per day in the middle of 1990. Dependence was rising rapidly on the Middle East, and the question of the timing of capacity additions was moving to the fore. This meant that the world oil market was becoming increasingly crisis or accident prone. Yet, for the most part, these trends were simply ignored or waved away with the refrain that oil would always be available. If you will forgive me, I think what I observed in those hearings last March is still very relevant to how we got to this point: "The world of quotas is over. The surplus era seems to be over, at least for the time being, and OPEC is operating at a very high capacity rate. That means that there is not much give in the market. . . . You can start making a list of things and suddenly you can see . . . the kind of event that can cause a shock, a temporary shock, but the consequences of it can be very destabilizing to the economy." [2] A few years ago, the world oil market could have lost four million barrels per day and with no difficulty made up that loss. Today, with the loss of Iraq and Kuwait, we are scrimping by, and there is essentially no give at all in the system. There is no spare capacity, and indeed apparently not quite enough capacity to meet demand.

The high prices we are seeing today reflect two components: One is the significant disruption in supplies, the tautness in the market, the problems of crude quality, the logistical disruption (which should get greater attention), and so forth. This disruption is on the same scale as 1973 and 1979. The other component is anxiety and fear. What pushed up the price over the last couple of weeks specifically, in addition to the fundamentals of supply and demand, were the Iraqi moves on the foreign embassies in Kuwait and then Saddam Hussein's verbal threat to the Saudi oil fields. We will see the oil price rise and fall on fears and expectations of militarily conflict at any given time. The blunt fact is that, in addition to registering market conditions, the oil price today has become a thermometer that measures war fever.

Will oil prices go higher? There are forces that will work against that—the recession, the conservation response to higher prices, and the existence of inventories. And we have a great source of strength that we did not have in previous crises—the Strategic Petroleum Reserve which was created specifically to counter disruptions and to ward off the severe economic harm of such disruptions. What could push prices up? The weather, unexpected accidents or bottlenecks in oil production and refining anywhere in the world—and conflict in the Middle East. Remember it is uncertainty or even panic that causes buyers—whether they be oil companies or airlines or industrial users or individual motorists—to build inventories during a crisis, and it is drive for higher inventories that pushes up the price.

(2) Looking back on the 1970s, we can see the stresses that this type of situation puts on our political system. Sharply rising energy prices hit the public hard, particularly lower-income groups. And the Kuwait crisis was neither in anybody's GNP projections nor in anybody's family budge. There is an inevitable cry to "do something" and that tends to get us off on domestic political controversies that miss the

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[1] U.S. Senate, Committee on Energy and Natural Resources, World Oil Outlook: Hearing, 101st Cong., 2nd Sess. (Washington: GPO, 1990), pp. 2, 32.

[2] *Ibid.*, p. 99.

point that there is a real disruption in the world. Given a little time—and the stimulus of price—the global logistical and supply system can adapt. In the meantime, we should try to restrain the emotional reaction: "During the oil crises in the 1970s, the United States political system was paralyzed in the face of one of the biggest and most costly disruptions of the postwar era. Anger, finger-pointing, scapegoating—all became a substitute for the development of a rational reaction to a very serious problem." [3] I hope that this particular crisis does not develop into an extended affair, if it does, I certainly hope that we, as a country, can keep our eye on the ball and the main issues. Short-term expedients, like price controls and allocations, end up imposing a long-term cost on the nation and impede the adjustment. Many of you will remember the irony of the gas lines—shortages in the cities and areas of population growth, with gasoline to spare in resort areas to which no one could get. But the reaction of suspicion is deep-seated in American culture. The first hearing on high gasoline prices that I found in my research was one conducted by Senator Robert "Fighting Bob" LaFollette in 1923. Senator LaFollette warned that gasoline prices would soon hit a dollar a gallon. (Though, as it turned out, they fell to 13 cents a gallon, it was in the course of those gasoline hearings that Senator LaFollette stumbled onto Teapot Dome.)

(3) This crisis once again demonstrates the importance of a coordinated international response among the industrial nations through the mechanism of the International Energy Agency. There is only one oil market, and all buyers are affected. The IEA helps to modulate the rivalries and suspicions and fears, which in general fuel panic and, in this case, would undercut the remarkable international consensus that the administration has forged. Since we in the United States do not see and hear these suspicions, we tend to underestimate them. We do not appreciate the way that the United States is seen as the behemoth in the world oil market—the Saudi Arabia of oil consumption.

(4) Where do we go from here? Clearly, energy and oil are at the heart of this conflict, and a situation in which we depend on an increasingly-taut world oil market holds unacceptable costs. Even if there had not been an invasion of Kuwait, the market would have been riled by other serious problems, if not outright crisis, in the years immediately ahead.

Two directions are clear. One is to increase the use of North American natural gas and to move away the impediments to its use. The other is a renewed commitment to conservation. It is noteworthy that both were already being propelled forward for environmental considerations. Security concerns now do likewise. The original development of the interstate natural gas system was given a big boost by security concerns in the late 1940s. That is likely to happen again. It's often said that America failed on energy conservation. We disagree. Between 1973 and 1985, the United States became 25 percent more energy efficient and 32 percent more oil efficient. If the United States had stayed at the 1973 levels of efficiency, it would have used the equivalent of 13 million barrels of oil per day more than it actually did in 1985. But, it is also true that in the period of low prices after 1986, conservation flattened out. In contrast to the 1970s, there is wide recognition that conservation has a very important contribution to make to our economic well-being and our security. But the argument ahead is how to achieve it—whether to urge it, or price it, or tax it, or regulate it. I imagine that will be a subject of considerable discussion in the future.

(5) Rapid growth in U.S. oil imports is not only expensive for this country but destabilizing for the world market. We do have to address the U.S. oil production decline and what can be done to slow it. U.S. crude and condensate production has fallen 1.6 million barrels since 1986. In the March 1990 hearing, Senator Johnston asked what might be expected in terms of future decline. Let me now offer our projection: by the year 2000, it could well fall by about another 1.5 million barrels. These are numbers with global implications:

U.S. Oil Production (crude and condensate): 1985, 9 mbd; 1990, 7.4 mbd; 2000, 6 mbd; and 2005, 5.6 mbd. (Source: Cambridge Energy Research Associates.

Looking back, we can see that the United States rather wantonly let a lot of oil production evaporate that is not recoverable. The production loss might have been mitigated, but that is history. The loss of that production turns out to be a heavy cost for the whole nation, as every motorist is finding, and as we see recession stalking the economy.

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[3] Daniel Yergin, *The Prize: The Epic Quest for Oil, Money and Power* (New York: Simon and Schuster, November 1990), p. 775.

(6) We should certainly take a very hard look at the directions of effort in research and development. To Senators who have been swamped in the budget deficit struggle, the last thing one wants to do is suggest spending more money. But R&D is our seedcorn. Unfortunately, changes in the way America does business appear to have had a pernicious effect on corporate sector spending on research and development; and it would make sense to ensure that we are pursuing a diversified portfolio as a nation when it comes to spending in this area.

(7) The North-South struggles of the 1970s seem to be behind us—for the most part. With the sovereignty issue firmly resolved by oil producing nations, the possibility exists for more creative relationships between the United States and the various oil producing nations, which would meet those nations' objectives and also encourage energy production. That is certainly the case here in this hemisphere, with Venezuela and Mexico.

(8) In the 1970s, the biggest source of contention in the domestic energy arena was the economic clash—producers versus consumers, markets versus regulation. From the vantage point of today, the central clash in the 1990s looks to be different—between environmental and supply considerations. How do we find the balance between these legitimate and competing concerns? The reality is that the environmental consensus has broad support and has become an integral part of our political process and our national culture. Yet it is not less true that the production and consumption of energy are intimately linked to our economic well-being and our security and strength as a country. Will the conflicts between these two sets of concerns be resolved only on a case-by-case basis, issue-by-issue, the outcome depending on the constellation of forces at a given time, or can we find some form of medication? I do not see any clear answer at this time. But that question will provide the context in which so many energy issues will be fought out, and it behooves all of us to apply ourselves to the critical question of the framework for approaching them.

(9) One characteristic of the reaction to the 1970s was to build flexibility into energy consumption. The one sector where that has not occurred, of course, is transportation. There will certainly be a renewed effort to diversify the fuel sources for transportation, perhaps with existing technologies, perhaps with new ones. At the same time, great efforts will be made to increase the fuel efficiency standards for the automobile fleet. All that I would like to do at this point is note that changing the fuel source and increasing efficiency both will involve tens of billions of dollars. New fuel sources on a scale to be significant would require a massive new infrastructure.

(10) Finally, let me conclude with a lesson that Winston Churchill enunciated some 77 years ago, when he was leading the effort to convert the British Navy to oil. But Britain did not produce oil, as Churchill knew so well, only Welsh coal. His answer to the security problem posed therein was diversified: "On no one quality, on no one process, on no one country, on no one route and on no one field must we be dependent . . . Safety and certainty in oil lie in variety and variety alone." [4] The case for diversification of options was overwhelming at the beginning of the twentieth century. The Kuwait crisis reminds us that it is no less applicable at the end of the twentieth century. What was wisdom for Winston Churchill in 1913 is wisdom for America in the 1990s.

Senator BINGAMAN. Thank you very much, Doctor. Let us hear from all of the witnesses before we start questions.

Our second witness is Dr. John Gibbons, the Director of the Congressional Office of Technology Assessment. Dr. Gibbons is an expert in energy and environmental issues. Prior to joining the Office of Technology Assessment, Dr. Gibbons served in positions at the University of Tennessee, Oak Ridge National Laboratory and the Federal Energy Administration.

Dr. Gibbons, thank you for being here.

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[4] *Ibid.*, p. 160.

STATEMENT OF DR. JOHN GIBBONS, DIRECTOR, OFFICE OF TECHNOLOGY ASSESSMENT

Dr. GIBBONS. Mr. Chairman, thank you. I have submitted my full testimony for the record, along with a couple of attachments, and I would only like to summarize those remarks this morning.

Senator Ford wanted some short answers this morning, and I think I can quote from Pogo when he said, "From here on down it is uphill." My testimony here this morning will focus on the longer-term issues—the simple arithmetic and the compelling case for the Nation to be about its business.

Let make three points. First, the U.S. oil supply and demand are obviously on a rapidly diverging path. There are no quick fixes. There are no easy fixes, and we must set long-term goals, a program to go with those goals and stick with it through thick and thin, high price and low price, because change in this system is inherently slow.

It involves putting into place technologies and investments, replacing capital stock—things that are inherently multiyear, if not multidecade in their very nature.

The second point, energy policy should be crafted not in isolation, but to support the overriding goals of economy, environment, and national security. Some energy options are better aligned with these multiple goals than are others.

The third point: some years back we used to think of the fossil fuel age as an age that would last mankind for probably several hundred years, and now seemingly endless tribulations in the Middle East where most of the oil is, and environmental and global climate concerns could greatly constrain our thinking about the length of time in which we can use fossil fuels, especially as we move to the lower grade fuels.

What does that mean? It means that the time that we have left for the fossil fuel age is less than we thought—several times less probably—and that we have perhaps 50 years to make our move to a transition to a nonfossil-fuel world. That means solar and nuclear are our options, gentlemen, and it takes at least 50 years to put that system into place.

Let me remind you very quickly with several slides of what our situation is.

[Slide.]

Dr. GIBBONS. The first slide simply points out that of the 17 million barrels of oil a day we use, we are importing 8 million barrels, and of that 8 million barrels, 2 million barrels per day are coming from the Mideast and our dependence on Mideast oil has grown substantially over the past decade. About a third, or 29 percent of the Mideast oil is the Kuwait and Iraqi oil.

[Slide.]

Dr. GIBBONS. The second figure breaks down our consumption of that oil into the sectors. The top line is our total consumption and the distance between the top line and the next line is that consumed in transportation, et cetera. They are summed up together.

Residential and commercial eats up 8 percent of our oil; utilities, now 5 percent and falling; industry, 24 percent; and transportation, 63 percent of all of our oil use. Of that 63 percent, 40 percent, two-thirds of it, goes into cars, vans, light duty vehicles that carry people.

[Slide.]

Dr. GIBBONS. The third slide shows you where in the transportation energy use we are as of 1987. Again, I broke out for you along the top line the important role of trucks and vans now, a growing fraction of our light duty vehicles, so if we talk about transportation efficiency, and rules of the road for transportation efficiency, we must keep in mind that vans and light trucks, need to be folded in with automobiles or else we are going to miss an important set of opportunities.

Well, therefore, what do we do? There is an easy answer. We need to slow down demand and increase supply, do we not? How do you do that? I want to mention five strategies. First, greater efficiency in the system, generally across the system and this takes price signals, strong, consistent price signals that are vagaries of the night, but are laid in place and guaranteed to be there for a long time.

If you do not have that, people only respond to price in the way they use their present equipment. If the price is an assured, future event, then people will take that into account when they make their purchase decisions and will be buying more efficient equipment.

We could start with Federal purchases themselves and Federal operations which, despite years of effort, are still notoriously poor in terms of energy efficiency. OTA will be reporting on this to Congress in mid-winter.

We could also think about research and development, the traditional role of the Federal Government in helping long-term national needs.

[Slide.]

Dr. GIBBONS. And the next chart shows the rather woeful case of administration requests, which is the solid line, and the Congressional appropriations, which is the dotted line, for conservation R&D budgets since 1980.

You will notice that Congress has buffered a rather wild swing of administration requests and in fact, in recent years has been running twice the requests of the administration. That is all for that slide.

So the first point is greater efficiency through the system. The second is greater efficiency in the transportation sector, which I remind you is two-thirds now of all our oil use. We must focus, as I mentioned, on the price and performance of automobiles, light trucks and vans.

If you do not have a price signal that is strong, then efficiency standards will have a hard time holding up in the marketplace. These need to complement each other rather than to conflict. I note, and you know well of S. 1224 which recently failed in the Senate, which would have pushed our performance requirements for the light fleet over the next 10 years. I will return to that in a moment.

Now let me go to the supply side. There are alternatives to oil. Obviously, you can make alcohol and hydrogen out of coal. The problem is that in the process you are making a lot of carbon dioxide and other atmospheric problems that haunt us these days.

Natural gas is a terribly important option that we must count on. It is a domestic fuel that can be used as natural gas, compressed or liquefied, or you can turn it into alcohol. So that is a very important, I would call it transition or swing fuel.

But finally, once we run down on our natural gas supplies, and this will not be many decades, we will have to look to renewable sources from the sun, directly or through biomass, and through nuclear power to present us with opportunities for liquids or hydrogen gas or electricity.

Let us talk about ANWR for a moment. Here is the environment and development battleground we all know about. It is probably the last major U.S. province for super giant fields. If we are optimistic about what might happen up in ANWR and assume that exploration will go, that we will make the kind of finds that we hope for, what kind of production?

Well, after 12 to 15 years following discovery, we could probably get up to several hundred thousand barrels a day of oil from ANWR, an important number in this regard, but I will put it in context in a moment.

Finally, what about development of oil resources outside the Mideast? As Dr. Yergin has pointed out, if we can spread out this base of world oil, we are going to have a much easier situation.

We are drawn particularly toward the U.S.S.R. It is a major province, not fully explored, probably one of the greater areas on the whole globe for future major oil discoveries, and if we can encourage by a variety of mechanisms joint ventures, whatever may work out, a U.S./U.S.S.R. participation in the exploration and development and infrastructure of Soviet oil, that could provide an important source of supply for the U.S. and the Soviet Union in the years ahead.

Now I want to summarize, gentlemen, what all of these numbers do. You know, George Bernard Shaw once said that mankind would rather commit suicide than learn arithmetic, and we are just going to do some simple arithmetic this morning and see how it adds up.

So let us go to Figure 5.

[Slide.]

Dr. GIBBONS. Again, the bottom line shows our production of natural gas liquids and other liquids out to the year 2020. We add the Alaska field, the North Slope, in red. We add the Lower 48 which gets us up to the green line, and you see we have peaked up, as everyone knows, and rolled over and are on a decline, even assuming increasing price from here on out. Then there is a big gap which has to be imports in order to get to a baseline of demand, which is the top line.

We make certain assumptions on the demand side; namely, in this first slide that our present 28-mile-per-gallon automobile fleet requirements simply stay in place. We do not change that. Our vehicle miles traveled each year and our population growth and our real GNP growth also drive this curve.

Now see what happens when we make a few scenarios.

[Slide.]

Dr. GIBBONS. The next slide shows the same business, except now we are adding Alaska 2, which is North Slope, 0.5 million barrels per day, and we are also adding some more alternative fuels, 0.5 million barrels per day. You see that begins to pull up the bottom and narrow the distance between the black line and the blue line, which means our net imports are not expanding quite so rapidly.

A major effort, though, does not make that much difference, it seems, in the longer run, does it? Let us go to the next chart and see what happens if we start talking seriously about automobile and light duty passenger vehicle fleets.

[Slide.]

Dr. GIBBONS. We see if we go to a 38 mile per gallon by 2010 which is effectively very close to S. 1224, this brings down that top line significantly. If we were to move to a light duty fleet of 50 miles per gallon by the year 2010, you see we pull that line down even further. It is a very significant equivalent to many millions of barrels per day of oil saved, less requirements.

Again, the area there called net imports is one we have to worry about.

[Slide.]

Dr. GIBBONS. Finally, in the last chart we make another heroic assumption. We assume that we take all the rest of oil that we use in the system and cut it in half by switching to gas, by doing a variety of things. This is in residential, commercial industry, utilities, and the rest of the transportation sector. That pulls that demand down to the red line which tells us the bottom line is that with all of these measures we might end up in 2020 with about 50 percent oil import requirements. That is the simple arithmetic.

Now let me conclude. Dramatic and sustained efforts are going to be required to hold down oil import dependence over the next several decades even to a level of 50 percent. Virtually all of the important options up there, you will note, are in the demand side.

Second of three conclusions, the supply of recoverable oil resources is huge around the world, but it is mostly in the Middle East. If we could help the Soviets expand oil production in return for a share of it, that might have several benefits for our side.

A third conclusion, while we scramble for oil now we really need a commitment to this transition to the post-fossil fuel age as well as an era of further advances in energy efficiency. The specter of global warming and other environmental issues could greatly foreshorten the time that we once thought we had to use coal, shale and other materials.

There is an ancient Chinese comment worth repeating. If we do not change our direction, we are very likely to end up where we are headed.

Thank you.

[The prepared statement of Dr. Gibbons follows:]

PREPARED STATEMENT OF DR. JOHN GIBBONS, DIRECTOR, OFFICE OF TECHNOLOGY ASSESSMENT

Mr. Chairman and Members of the Committee, I appreciate the opportunity to testify today on the subject of our nation's oil dependence. OTA has been studying this and other energy issues for the Congress since the mid-1970's.

I have attached to my testimony today a selected list of reports which we have delivered to the Congress on this and related subjects. In addition I have included a list of projects underway at OTA which will either update or provide new analysis on energy matters.

I will consider my testimony today a success if I can convey to the Committee three critical ideas. First, there are no "fixes" that are easy or quick. We will succeed in easing U.S. oil dependence only if we set long-term efficiency and supply goals, set up a multi-year import reduction program, and stick to the plan through periods of both crisis and calm, and through periods of high and low oil prices. During the decade that has just passed, steady supplies, efficiency gains, and a retreat in the price of oil seduced us into largely abandoning our efforts in energy conservation and production research. The present crisis, too, will pass, possibly again beguiling us into false energy bliss. Major changes in energy systems—and major changes are what must occur—require many decades and unwavering commitment from citizens, political leaders, and industry.

Second, a responsible energy policy will complement as much as possible a responsible environmental policy. There are options for energy which run counter to environmental goals. There are other energy options which support environmental goals. The same can be said for our nation's economic and security goals. Consequently, we should seek and follow long-term energy goals which, to the maximum extent possible, are consistent with the overriding goals of economy, environment, and security.

Third, barring the kind of extraordinary surprise that only fools would count on, we must develop non-fossil fuel options to drive our nation's energy economy. Until recently, we counted on coal, shale, and other less premium fossil sources for the future but the specter of air pollution and potential climate change now strikingly constrain that option for the long-term. This means that solar and nuclear power must be considered as the energy sources for mankind that may have to become dominant within a half-century or less. And that, in turn, means we must embark on that Odyssey now.

Figures 1-3 illustrate the magnitude of the oil import dependence problem. They show the past, current, and projected trends in U.S. oil usage. I believe the data fairly represent what one should expect in a surprise-free future, i.e. absent policies domestic or foreign to dramatically alter the 3 course. Clearly, U.S. production of petroleum, despite an extended period of doubled and tripled prices, has peaked and moved downward in the U.S. since about 1982. This trend will almost undoubtedly continue, and production could drop to half our present amount in the early part of the next century. Meanwhile if recent trends continue, our oil demand will continue to rise, presumably to be met principally by increased imports from the Middle East. That's a very troubling scenario to most people—one that fairly begs for exploration of alternatives.

I would like now to review with you a few critical policy areas where Congressional action could make a long-term difference.

ACCELERATING ENERGY EFFICIENCY GAINS

Many of the easiest energy efficiency investments have been made, and future investments may be more difficult to stimulate. Nevertheless, rapidly changing technology has generated many new conservation options. Sizable future efficiency gains in all sectors of the economy are becoming economically attractive and commercially available, and could constitute the cornerstone of a comprehensive strategy for slowing the increase in oil imports in the 199Os. Additional benefits of increased efficiency include improving international industrial competitiveness of U.S. goods and services, addressing local environmental concerns such as acid rain and urban ozone, and finally, helping to ameliorate global environmental concerns such as greenhouse warming.

Only clear price signals can assure that available energy efficiency gains are fully and quickly realized. Short-term price spikes will be ignored in terms of investment decisions. Congress must assure that higher fuel prices to reflect national need for economic and environmental security are virtually certain over the long-term. Some otherwise-attractive efficiency gains are lost because of a variety of roadblocks that the Federal government could help overcome. If Congress demanded efficiency standards or instituted requirements that banks take account of energy use in evaluating mortgage requirements, major efficiency improvements would result. The Federal government itself ought to be, but most definitely is not, at the forefront in installing and promoting efficiency technology and design in its own purchases, facilities, and operations. OTA will be reporting to Congress on this issue early in the next session.

Failure to pursue strong efficiency gains through an active research and development program is hurting our progress towards a more energy efficient economy. Over the past decade, the Federal government's commitment and leadership in energy matters fell sharply. Only congressional action kept the Department of Energy's energy research budget from being virtually eliminated in some areas. The budget for energy conservation, which should be the centerpiece of any U.S. strategy to reduce oil dependency, has been cut drastically. Figure 4 illustrates how this budget was cut in half between 1981 and 1990. The administration's current budget proposal, formulated prior to the Iraqi invasion of Kuwait, calls for another $10 million reduction despite DOE's statements of renewed interest and support of conservation initiatives. With the current crisis, a sense of urgency has returned, but I fear that a successful outcome in the Middle East will return us to a state of disinterest in supporting oil use reduction.

IMPROVING AUTOMOBILE FLEET EFFICIENCY

Automobiles and light trucks account for 40 percent of U.S. oil consumption. The efficiency of the new vehicle fleet, increased sharply with the advent of higher fuel standards and prices. But gains have ceased in the face of government apathy, apparent consumer indifference to fuel efficiency, and industry emphasis on increased vehicle acceleration, size, and other characteristics that conflict with improved fuel economy.

There is clearly some sentiment in the Congress to raise the fuel economy of the new car fleet through some kind of extension of the current CAFE standards; one recent proposal sought new car fleet fuel economy targets of about 34 mpg by 1995 and 40 mpg by 2001, to be attained by uniform percentage increases in each automaker's current fleet mpg level. In seeking to enact new fuel economy standards, however, Congress needs a reasonable and trustworthy estimate of the technological potential for further efficiency improvements. Congress must also determine the extent to which the United States' oil dilemma justifies influencing consumer choice regarding vehicle size, performance, and other characteristics. Although OTA believes that there is a substantial potential for further fuel economy increases through purely technological means, without diminishing consumer choice, the magnitude of this potential within the next decade is not what we would like it to be. (Our best guess for this potential is for new car fleet fuel economy of about 31 mpg by 1995 and 36 mpg by 2001, both values measured according to the EPA test procedure.) Longer term progress, beyond the year 2000, could conceivably be much larger if strong continual incentives for fuel economy are brought to bear on the industry. If Congress believes that larger gains in fuel economy are necessary then it could mandate a basic shift in the size and performance of the fleet either through regulatory or economic means.

Because today's auto purchasers feel free to choose among both the automobile fleet and the fleet of light trucks in their search for passenger transportation, Congress will have to exert the same pressure on light trucks as it exerts on automobiles if its fuel economy goals are to be met. (Fig. 3)

DEVELOPING ALTERNATIVES TO OIL

The transportation sector of the U.S. economy consumes 63 percent of our total supply of domestic and imported oil. Obviously, the introduction of non-oil based liquid fuels is an important adjunct to increased fuel economy in reducing U.S. dependence on imported oil. Recent OTA analyses of several alternatives to gasoline have convinced us that alternative fuels present a key opportunity to reduce U.S. oil dependence, and are not merely an analyst's pipedream. Over the next few decades, alternative fuels derived from natural gas—methanol and compressed natural gas (CNG)—should be capable of substituting for a significant fraction of transportation petroleum use. The worldwide resource base for gas is very large, and considerable volumes of undeveloped gas resources exist outside of the Middle East, including large volumes in the Soviet Union. Other non-petroleum fuels such as ethanol and, possibly, electricity in niche markets could play a role in this time frame as well. These fuels could serve as a bridge to eventual use of fuels such as electricity (in more general highway use) and hydrogen in the long-term. Electricity and hydrogen currently have serious practical and cost constraints and would require a major development effort. Eventually, however, they could greatly diminish greenhouse gas emissions by largely replacing fossil-based transportation fuels.

Coal-based liquid fuels currently are considerably more expensive than natural gas-based fuels. However, continued development of the fuel production processes have lowered costs and, in the future, may lower them sufficiently that this source could compete economically with fuels from natural gas. Large U.S. coal reserves make coal-based liquid fuels attractive if energy security is viewed in isolation. However, coal use presents serious environmental problems, and the nation cannot afford to ignore these in the process of deciding which liquid fuels to pursue.

DRILLING THE ARCTIC NATIONAL WILDLIFE REFUGE AND OTHER "OFF-LIMITS" AREAS

The rapid decline in U.S. oil production and the scarcity of new opportunities for finding large new oil fields within the lower 48 leads some to suggest that the federal government open to exploratory drilling and development a number of promising areas currently off-limits to these activities. The oil industry considers the coastal plain of the Arctic National Wildlife Refuge (ANWR) to be the United States' most promising remaining prospect for finding giant oil fields, and they have made it the central focus of the debate for opening new lands for commercial exploitation. The Department of Interior has calculated that the area has a 19 percent chance of containing economically recoverable oil, with a mean estimated oil volume of 3.2 billion barrels—a potential resource that, for a few decades, could deliver several hundred thousand barrels of crude oil per day to the lower 48 States. Groups opposing development view the coastal plain as a unique and invaluable Arctic ecosystem and wilderness area, and are convinced that development would destroy the plain's wilderness character and seriously damage its wildlife and other environmental values.

The debate over ANWR development is a classic battle between environmental and development interests. Although an exploration program could be conducted with little damage, development and production would certainly cause disruption and damage. In any case, oil could not start flowing from the plain for many years. The industry's own estimates of the time from actual leasing of the plain (which itself will take a few years) to production startup is about 12 years, and peak production would not be reached for a number of years after that. Even if Congress were to act swiftly to open the coastal plain to exploration, with an accelerated leasing schedule, and if the industry were to move as rapidly as possible, it is difficult to see how production could begin before the year 2000. And the value of the oil is itself in dispute, with the industry characterizing the potential oil volume as a critical component of an import reduction strategy and the environmental community characterizing it as a tiny part of such a strategy, easily overshadowed by increases in efficiency of engines. With ANWR being potentially capable of supplying perhaps 2-5 percent of total U.S. oil supply, the reality clearly is somewhere in between.

PROMOTING NEW OIL DISCOVERIES AND PRODUCTION IN THE EASTERN BLOC NATIONS

The radical changes in the political reality of the Eastern Bloc that have occurred over the past year have added a new potential oil strategy to the usual list—assisting the Soviet Union and its neighbors to find and develop new oil fields, rescuing some of their mismanaged fields from fast decline, and putting in place an efficient infrastructure for production and export. The USSR petroleum resources are not well-explored and could be quite appreciable. Aside from the direct value of the oil to the United States, the benefits of such an effort extend to boosting current Soviet efforts to change to a market economy and helping to spread world oil supply beyond the Mideast.

CONCLUSION

(1) In Figs. 5-8, we summarize the impacts—in size and timing—of several aggressive strategies we have discussed. Clearly, dramatic and sustained efforts would be required to hold down oil import dependence over the next several decades—even to a level of 50%. Virtually all of the major opportunities lie on the demand side. To the extent that we improve efficiency, supplies will last longer, environmental problems will be eased, and international tensions will be lessened. Time is an essential feature: like making a turn in a fully loaded supertanker, change must be slow if it is to be non-violent.

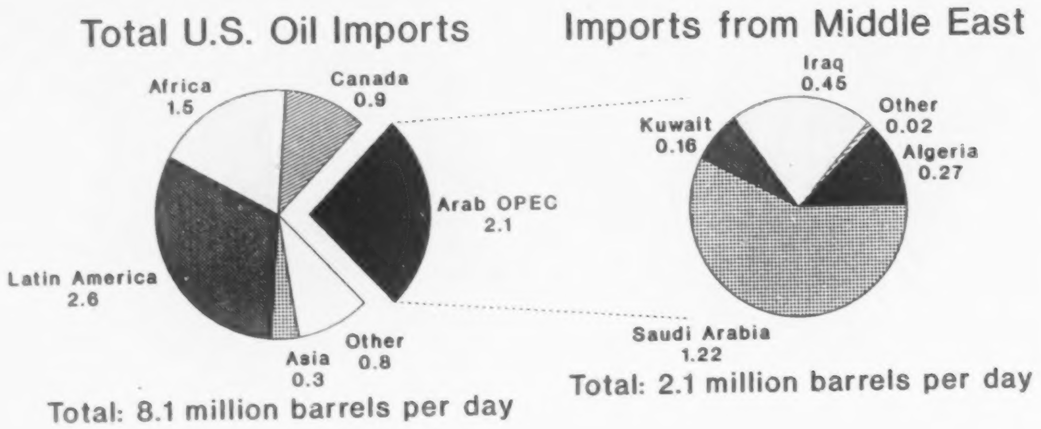
(2) The supply of recoverable world oil resources is huge, but it is mostly in the Middle East. Furthermore, with other nations seeking increased imports, it is not safe to presume that we can count indefinitely on 8-10 MPBD oil imports at an affordable price. If we could help the Soviets expand oil production in return for a share of it, that could have several benefits to us.

(3) We need commitment to the transition to post-fossil fuel age as well as an era of advancing energy efficiency. It will take several decades from whenever we start to wean ourselves from imported oil. Our long term economic, environmental and

national security future hangs on this transition, and the specter of global warming could greatly foreshorten the time we once thought we had.

There is an ancient Chinese comment worth repeating here: "If we do not change our direction, we are very likely to end up where we are heading." At present, we are headed toward years of global tensions and conflict over increasingly costly Middle East petroleum if we continue to procrastinate.

Figure 1
U.S. Oil Imports: 1989
(millions of barrels per day)



Total U.S. Oil Consumption, 17.3 MMB/Day

Figure 2
U.S. Oil Consumption by Sector

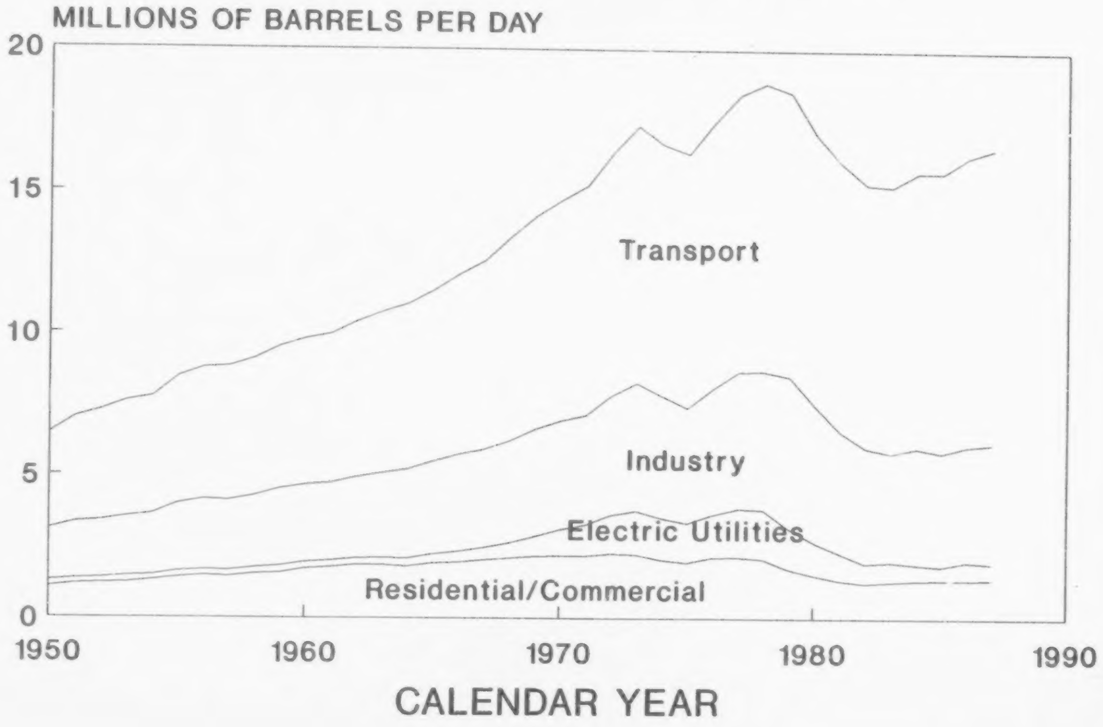
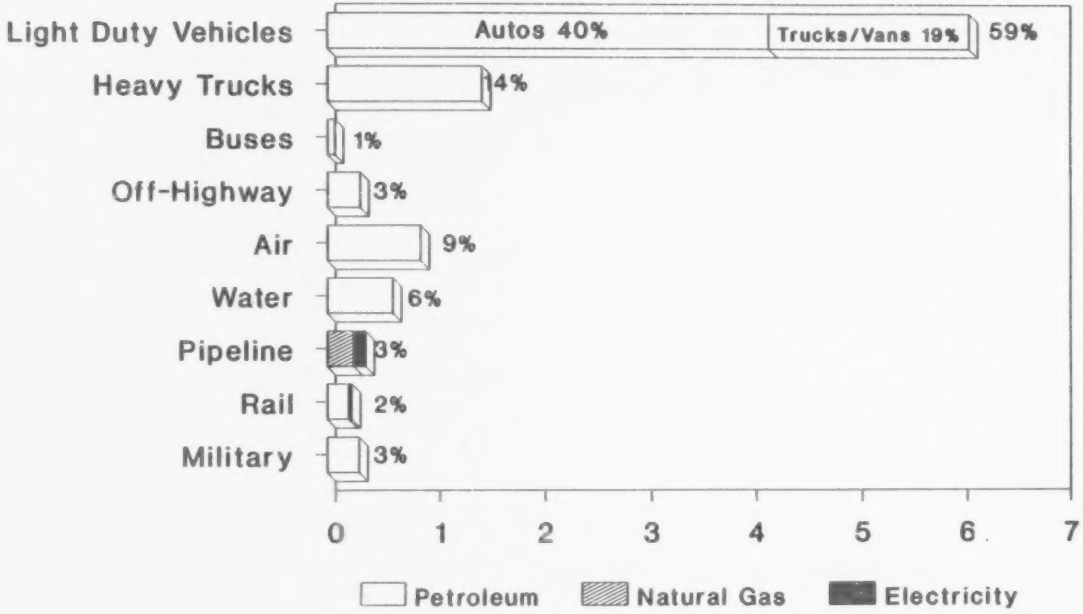
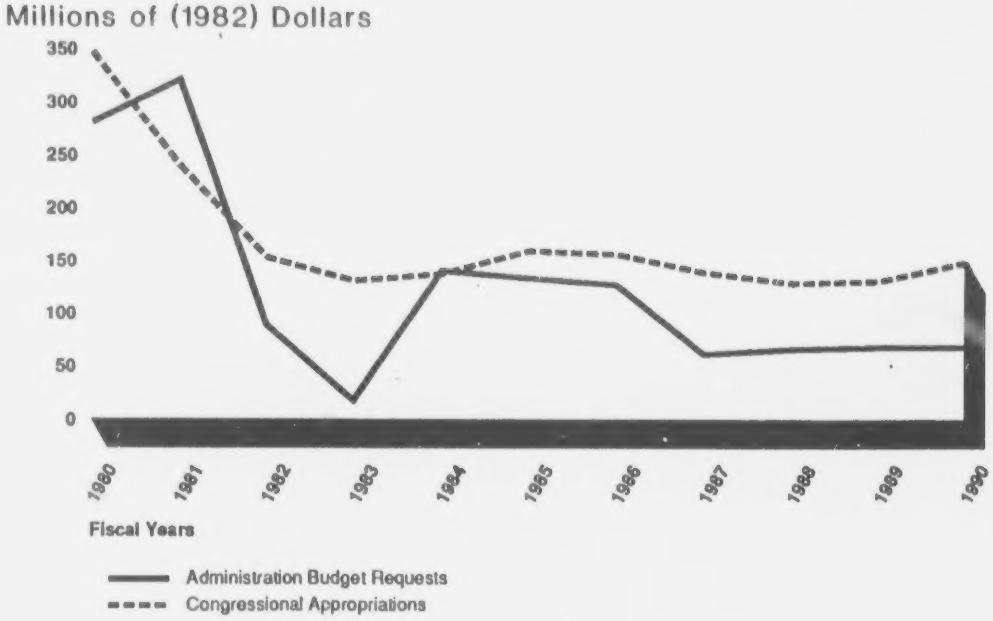


Figure 3
U.S. Transport Energy Use, 1987
(millions of barrels per day)



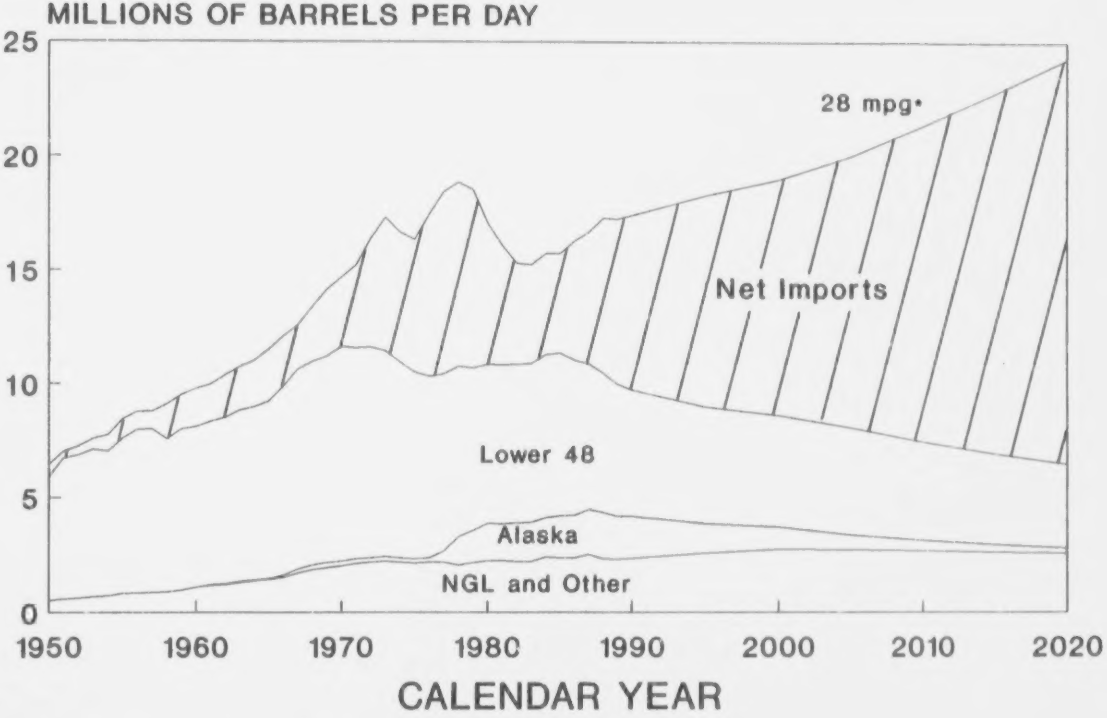
ORNL Transporation Energy Data Book

Figure 4
DOE Conservation R&D Budgets
Budget Requests and Appropriations



Source: General Accounting Office
GAO/RCED-90-195, July 1990

Figure 5
U.S. Supply and Demand Futures



Adapted From EIA, Annual Energy Outlook

Figure 6

U.S. Supply and Demand Futures

Alaska II and Alternative Liquid Fuels

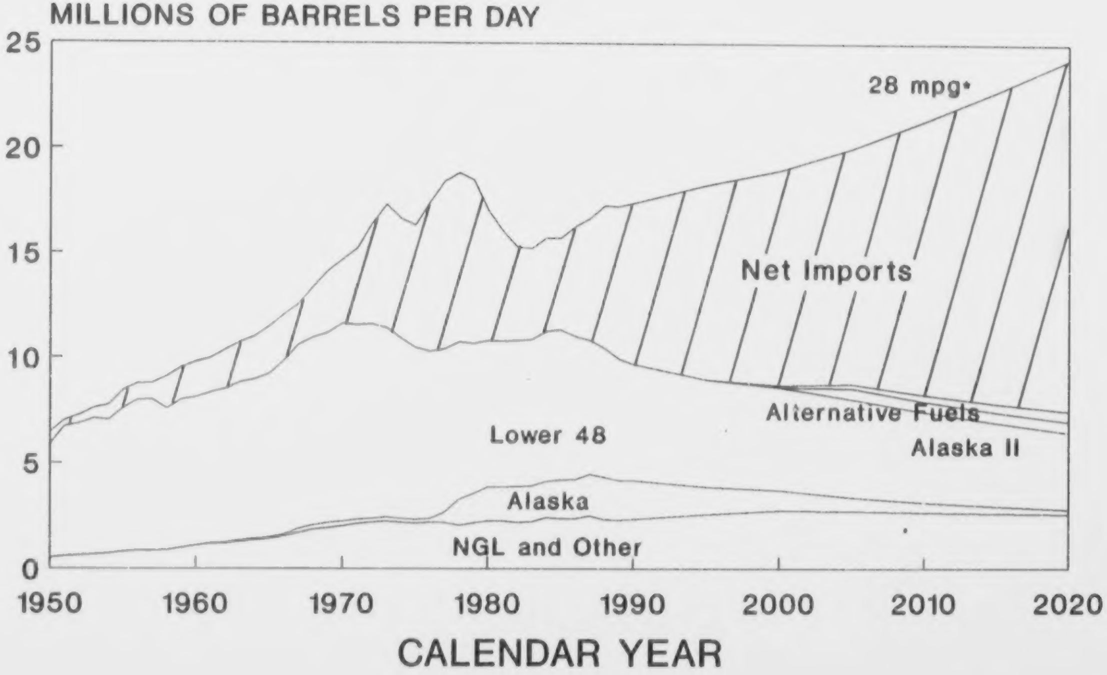


Figure 7

U.S. Supply and Demand Futures

Increased Supply and Improved Mileage

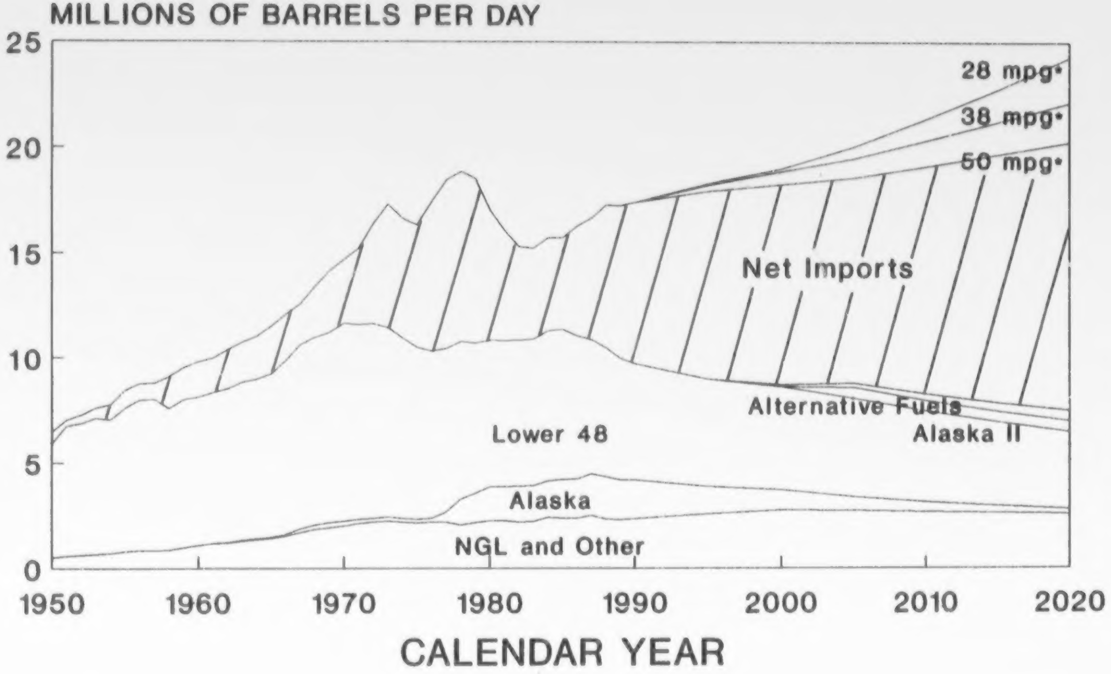
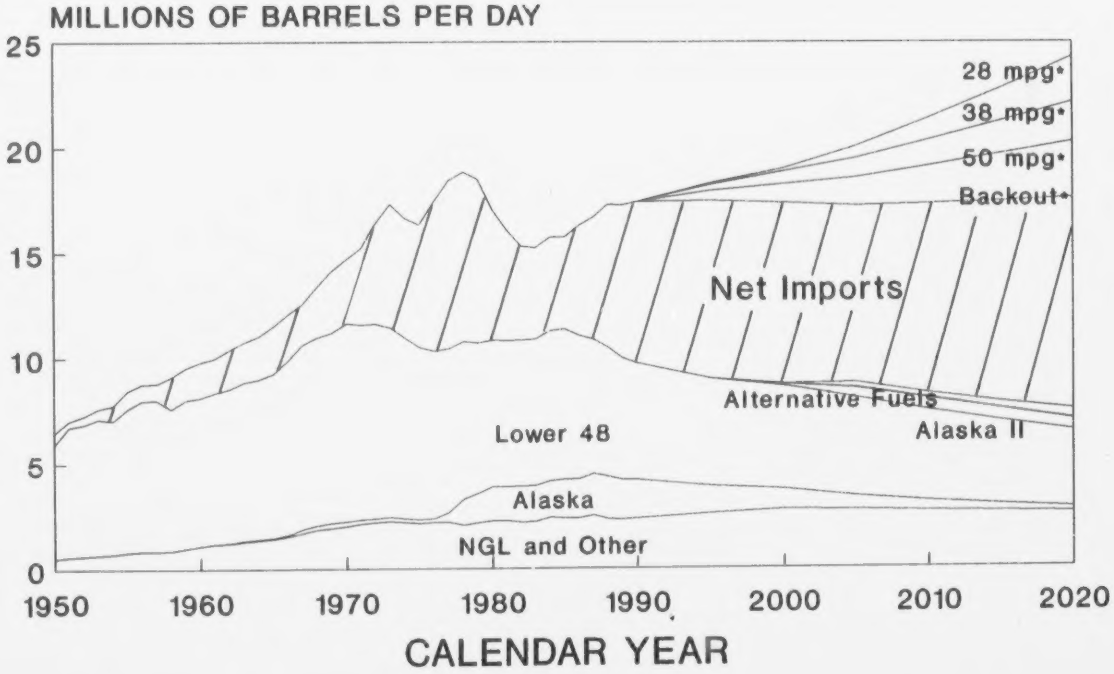


Figure 8
U.S. Supply and Demand Futures
Supply, Mileage, and Oil Backout



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Energy Efficiency of Buildings in Cities. March 1982; NTIS order #PB 82-200 346.

ASSESSMENTS IN PROGRESS

U.S. Energy Efficiency: Past Trends and Future Opportunities

Scheduled Release: Winter 1992
OTA Project Director: Peter Blair

The United States has achieved significant improvements in energy efficiency over the past decade-and-a half, prompting some observers to speculate that additional improvements will be much more difficult to obtain, especially in an era of relatively low energy prices. Nevertheless, many technologists argue that the potential for improved energy efficiency in virtually all sectors of the economy is far from being fully utilized. Many policy makers consider continued improvements essential as Congress faces such issues as slowing the increase in oil imports in the 1990s, improving international industrial competitiveness of U.S. goods and services, and addressing local and global environmental issues such as acid rain, urban ozone, and global warming.

As Congress addresses such issues in considering pending energy and environmental legislation and review of the Administration's ongoing formulation of a National Energy Strategy, it is important that the technological, economic, and institutional opportunities, shortfalls, and impediments associated with achieving improvements in energy efficiency be understood. This assessment focuses on the technical potential and commercial prospects for future efficiency gains. It will analyze what has promoted and deterred efficiency gains in the recent past, the research and development required to deliver new energy efficiency technologies, and alternative ways to accelerate commercial adoption of energy efficient technologies such as through efficiency standards, changes in energy pricing, or other regulatory mechanisms. The assessment will examine potential efficiency gains from the perspective of major end users: the residential and commercial sector, industry, transportation, and government, and the possible alternative roles of public and private sector involvement in promoting energy efficiency in these sectors.

In the course of this assessment OTA will draw heavily on its prior work in industrial energy use, analyzing trends in how energy use and the economy interact, examining the demand and supply outlook for energy, as well as its ongoing assessment on global climate change and extensive other studies.

Request or Affirmation of Interest:

Senate Committee on Energy and Natural Resources
- The Hon. J. Bennett Johnston, Chairman
- The Hon. James A. McClure, Ranking Minority Member
- The Hon. Timothy Wirth, Chairman Subcommittee on Energy Regulation and Conservation
- The Hon. Don Nickles, Ranking Minority Member Subcommittee on Energy Regulation and Conservation

Senate Committee on Governmental Affairs
- The Hon. John Glenn, Chairman

House Committee on Energy and Commerce
The Hon. John D. Dingell, Chairman
The Hon. Norman F. Lent, Ranking Minority Member
The Hon. Philip R. Sharp, Chairman
Subcommittee on Energy and Power
The Hon. Carlos J. Moorhead, Ranking Minority Member
Subcommittee on Energy and Power

Materials Technology: Integrating Environmental Goals With Product Design

Scheduled Release: Winter 1992
OTA Project Director: Greg Eyring

In response to tougher regulations and greater environmental awareness of consumers, companies are beginning to be more concerned with reducing the wastes they generate. As yet, though, few companies take responsibility for their products after they are discarded by consumers and enter the waste stream. The problem is complicated by the fact that designers are using more and more complex materials--e.g., multilayer food packaging--that are often difficult to recycle or re-use.

This assessment will explore how technologies for disposal or reclamation of post-consumer wastes could be coupled more fully to the initial product design process. It will examine how present economic incentives and environmental regulations influence choices made by designers, and what changes in public policies could encourage a new environmental ethic in product design.

Request or Affirmation of Interest:
The Hon. George E. Brown, Jr., Member, Technology Assessment Board

House Committee on Science, Space, and Technology
Robert A. Roe, Chairman

New Energy Technologies and the Developing Countries

Scheduled Release: Winter 1991
OTA Project Director: Joy Dunkerley

This study focuses on ways in which technology can contribute to economically and environmentally sound energy development in the world's poorer countries; and the role of U.S. policy in encouraging the rapid adoption of improved technologies. Principal questions are: do advances in technology hold the promise of providing the energy services that poor countries need for economic development, in a cost effective manner, without endangering the world or local environment? What can U.S. policy do to promote economically and environmentally sound technologies? How is the transfer of energy technology managed, and is there an opportunity here for U.S. exporters?

The study will also consider the role of developing country energy demand and greenhouse gas emissions and their relation to global warming and climate change. This assessment complements other work presently underway at OTA on policy options to reduce global greenhouse gas emissions.

Request or Affirmation of Interest:

Senate Governmental Affairs Committee
The Hon. John Glenn, Chairman

House Committee on Energy and Commerce
The Hon. John D. Dingell, Chairman
The Hon. Norman F. Lent, Ranking Minority Member
The Hon. Philip R. Sharp, Chairman
Subcommittee on Energy and Power
The Hon. Carlos J. Moorhead, Ranking Minority Member
Subcommittee on Energy and Power

House Select Committee on Hunger
The Hon. Vic Fazio

House Committee on Foreign Affairs
The Hon. Howard Wolpe, Chairman
Subcommittee on Africa
The Hon. Gus Yatron, Chairman
Subcommittee on Human Rights and International Organizations

House Committee on Banking, Finance and Urban Affairs
The Hon. Walter E. Fauntroy, Chairman
Subcommittee on International Finance, Trade and Monetary Policy
The Hon. Jim Leach, Ranking Minority Member
Subcommittee on International Finance, Trade and Monetary Policy

The Congressional Competitiveness Caucus
The Hon. Claudine Schneider, Co-Chair

Senate Committee on Environment and Public Works
The Hon. Joseph I. Lieberman, Member

Technological Risks and Opportunities for Future U.S. Energy Supply and Demand

Scheduled Release: Fall 1990
OTA Project Director: Alan Crane

In the first phase of the study, OTA evaluated the implications for U.S. energy policy of volatile oil prices, emphasizing the effects of low prices on domestic oil production, e.g., plugging of stripper wells and loss of production from tertiary and some secondary recovery operations in the shorter term, loss of production and reserves due to lower drilling rates, reduced R&D expenditures, and so forth in the longer term. In the second phase aimed at overall U.S. energy supply and demand, OTA is examining historic changes in U.S. energy supply and demand and the ability of previous forecasts to anticipate these changes. Next, the study will describe current forecasts for the next 15 to 25 years and identify their underlying assumptions. The study will then identify and evaluate the primary sources of technical uncertainties in the forecasts. The sources of technical uncertainty include: economic growth rates and patterns; new energy supply, conservation, and end use technologies; geologic uncertainties about available oil and gas resources; consumer reactions to lower energy prices, and other aspects of public and industry behavior; and methodological problems in forecasting. (The final report will discuss--but not extensively analyze--non-technical sources of uncertainty, primarily political uncertainty.) Finally, the study will identify and evaluate policy options that would add flexibility to the energy system, i.e., to increase the system's ability to adapt to the range of futures consistent with these uncertainties.

Request or Affirmation of Interest:

House Committee on Energy and Commerce
The Hon. John H. Dingell, Chairman
The Hon. Philip R. Sharpe, Chairman,
Subcommittee on Fossil and Synthetic Fuels

House Committee on Government Operations
The Hon. Jack Brooks, Chairman

Senator **Bingaman**. Thank you very much.

Our third witness is William Martin, who is a partner in the Washington Policy & Analysis consulting group, associated with the Miller & Chevalier law firm. During the Reagan administration he served in a variety of posts, including most recently the Deputy Secretary of Energy.

While at the Department of Energy, Bill Martin was largely responsible for the Reagan administration's 1987 energy security report. Earlier in his career he served as a Special Assistant to the Executive Director of the International Energy Agency in Paris.

Mr. Martin, go right ahead.

STATEMENT OF WILLIAM F. MARTIN, PARTNER, MILLER & CHEVALIER

Mr. **Martin**. Thank you, Mr. Chairman.

I think this committee over the last 10 years really has made a good effort to keep energy security before the Congress and also before the American people. Unfortunately, not too many people focused on it, and often we chatted here and we said, gee, we need an audience for what we are saying because we predicted in energy security that this country would be growing dependent on oil, that we could be at 8 million barrels per day by 1990, 10 million barrels per day imports by 1995, escalating to 12 million barrels per day by the end of the decade.

You said that; we said that. Even if it was net oil imports or gross oil imports which you often corrected me on, Senator Nickles from my home State, we said the same thing. Here we are today.

I think many of the proposals which the Congress has reviewed and decided upon in the past but not quite gotten through really are worthy of another look because maybe now we will have a political momentum behind us.

This morning I would like to focus on short term and long term. Having served in the IEA in Paris for 4 years, I always come at energy from an international perspective. One thing that is very important to remember is we may go our happy way and try to reduce our oil imports, but if our allies in Germany and Japan and Third World countries and, yes, the Soviet Union, do not get their act together, we are all going to face this problem again and again and again.

Right now in the short-term market we have lost 4 million barrels per day from Kuwait and Iraq. I add up in simple arithmetic that governments, the Governments of the U.S., Japan, Germany, and other IEA countries, have at their disposal 9 million barrels per day that they can bring on to the market one way or another. Together with Germany and Japan, we have 4 million barrels per day in our stockpiles which we could put on the market within the next few weeks. We also know that other producers have added 3 million barrels per day to the market, the OPEC countries. We also know we could have easy savings in fuel switching which can add another 2 million barrels. So together, we can overcome twice the shortage that might exist with a successful embargo of Iraq and Kuwait.

I think oil traders need to be aware of this. There is no reason why that price has to go much higher, because governments can step in and oil traders beware.

Now the IEA, for example, foresees a shortfall of 2 million barrels per day by the fourth quarter, and I think that is what most of us believe. If we have that disruption, let us put some SPRO on the market, but let us make sure that Germany and Japan put their oil on the market with us. For those countries that do not have stock, which is most of the other IEA nations, let us encourage them to build stocks and let us think what they can do to contribute their fair share in carrying this burden. I think that means demand restraint in the countries that have no stocks.

So I want to submit for the record today, in addition to my testimony, an excellent paper which Frank Potter, recently of Senator Gore's staff, in this excellent conference on global warming put together on stocks 6 years ago. It talks about the importance of stocks and how and when to use them in a crisis, and I think we are coming to that point today.

The final point, in 1981 when the Iraq-Iran war started, there was an international agreement in the IEA to "avoid abnormal purchases on the spot market." If all the IEA countries reiterated this policy internationally, that, too, could help moderate policy. So let us look to the IEA to do it, and let us encourage that body to take action.

I am depressed with Jack Gibbons' charts, a little depressed by them which shows over the long term we are vulnerable and indeed, this committee will be challenged to find a way to reduce our oil imports. We are never going to get rid of our oil imports, but let us at least try to freeze them at 8 million barrels a day, and think what can we do to keep imports at today's level?

And also, let us think about what we can do for the environment because this is the Energy and Resource Committee, but the environmental issue is very keen in the public's mind today.

Nobody yet has mentioned the domestic oil industry, and from my home State and for Don Nickles and Domenici and others, let me say, let us get domestic drilling going again. I think the rig count has fallen down to 900. It has been there since we talked about energy security.

Let us get it up to 3,000 again, and maybe that will take tax incentives. I think the President has proposed eliminating IDC's as a preference item. Maybe it will take more, but let us do it and let us get it through the Finance Committee. Let us also work to develop our Alaskan reserves in an environmentally sensitive way. We need those, that is basic.

And yes, Senator, I will be the first one today to mention coal explicitly. You have taught me about the value of clean coal technology on many occasions up here, and doggone it, 60 percent of our electricity today comes from coal.

We have to have that option, with all due respect to global climate change and so forth, but let us keep that program going and get clean coal technology here and figure out innovative ways to deploy it quickly. Once we have the technology, let us find a way to deploy it.

And let us again look at our coal exports. You know, one of the things we are trying to do and I tried to do was to cut the subsidies in other nations as we move towards free trade. Let us get in the GATT something that says, let us remove barriers to the free flow of coal because Germany, Britain, and Belgium, they all subsidize their coal. They should be buying American coal.

Nuclear, yes, we need to do something on nuclear, and Senator McClure and others of you know more than I do and know what to do about that. But we have got 100 plants today, and I am sure this committee will finally get something to do with licensing through. It came close before Chernobyl, came very close if I remember, and clearly we need to move toward standardized designs and clearly, the DOE has to finish the job on the waste site and so forth. So that is easy for this committee.

Gas, I cannot say anything more than Jack Gibbons did. It is a clean fuel. We all like it. I would like to say we have a free trade agreement with Canada which would enable us to bring more gas down and what about Alaska? What about Alaska? It sits up there. Maybe we need to look at that. That is 20 percent of our reserves.

Conservation, again, others on the committee are more expert on that than me, but let us make it an equal partner with supply. Maybe we need to look at CAFE standards. Maybe we need to look at alternative fuels for transportation as Jack has put out. And indeed, Government can again be a leader in conservation by getting our own house in order.

SPRO, some people have said, billion-barrel SPRO, now is the time that we need it and maybe we can do something innovative with leasing it from producers. Well that is fine, but let us not build a billion-barrel SPRO until we get commitments from the other IEA countries to equal a billion barrels.

We put in a billion, they put in a billion, and then we have 2 billion that we can draw down, but if we do it alone, we will be subsidizing the whole world, the whole world's energy security, not only our own. So let us get the IEA to work on that. Only Germany and Japan and the United States today have stocks, and that is sad.

I have only one innovative proposal today, Senators, because all of this, as Senator Wirth said, is a litany of what we have done in the past and should do in the future, but one idea I would like explored is that we are going to face the problem, if this situation in the Middle East is resolved, is the oil price going to collapse again, back down to $10, $15?

And are people who are going to make investments in alternative fuels or in drilling or in new forms of energy or in conservation, are they going to think, what if it collapses? Will my investment be gone?

And the one concept I bring to the table today which is new is to rethink the IEA's minimum safeguard price. This is a floor price which IEA countries agreed to in 1977 under the direction of Mr. Kissinger and they agreed that the price that was needed to safeguard alternatives was $7.

Let us look at that. Maybe we could have a $25 minimum safeguard price. Maybe we could have a $28 safeguard price. The reason I like to do this in the IEA is then every country would make that commitment.

If we do a floor price on our own or if we do an import fee on our own we shoot ourselves in the foot, but if it is an IEA-wide agreement, then indeed all countries will turn toward alternatives and conservation and it will be done in an equitable way and none of our countries will be hurt vis-a-vis the others.

Well, Mr. Chairman, I concluded at energy security with a comment that it will not just take conservation, it will not just take supply, we need both. It is not just an oil, it is an energy problem and finally, it is not just a domestic problem, it is an international problem.

And I think this committee has the wisdom and if not the wisdom, certainly the experience of having gone through this three times, and I think you will this time with the help of the administration craft a national energy policy.

Thank you very much.

[The prepared statement of Mr. Martin follows:]

U.S. Energy Strategy: Prospects and Policies

Testimony of

William F. Martin*

Before the
Committee on Energy and Natural Resources
of the
United States Senate

October 2, 1990

*William F. Martin was formerly Deputy Secretary Department of Energy from 1986 to 1988, Executive Secretary of the National Security Council from 1985 to 1986 and Special Assistant to the President for National Security Affairs from 1983 to 1985. Mr. Martin is presently a Partner of Washington Policy and Analysis - a Miller & Chevalier Consulting Group - in Washington, D. C.

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Executive Summary

1. There have been several threatening situations over the last twenty years in the world oil market. Today's situation is a reminder of the serious problems the U.S. and other countries encountered in the 1970s and 1980s in securing adequate oil supplies. The Arab-Israeli War in 1973 and the Iranian Revolution in 1978-79 wrecked havoc on international oil markets. However, faced with the Iran/Iraq war in 1980 which escalated into a tanker war in 1984-87, the IEA/OECD responded more effectively and oil price disruptions were minimized. These experiences have demonstrated what can happen when oil supplies are threatened and what approaches are most effective in dealing with the problem.

2. Saddam Hussein's aggression has thrown world oil prices into an upward spiral....a situation that continues worsen despite the fact that world oil markets have remained in equilibrium. While sufficient excess capacity exists in the world to offset the loss of Kuwaiti and Iraqi production—and Saudi Arabia and other producers have demonstrated their willingness to increase production to cover this shortfall—concern over the future availability of oil supplies will keep prices inflated in the short- to medium-term.

3. The crises of the 1970s and 1980s have left us better prepared to deal with energy emergencies, but there could be the temptation to "go it alone" by many countries, particularly if significant oil shortages materialize. Previous oil disruptions have taught us that international energy cooperation minimizes the disruptions—both economic and political—from an oil shock to all countries. We also learned that relatively small supply disruptions can result in large price increases, oil markets are highly interdependent and market forces are the superior method of price determination and oil allocation. Nevertheless, the economic and political costs a shortage could entail could tempt some countries to abandon international coordinated response efforts set in place for energy emergencies and pursue country-specific solutions instead.

4. With history as our guide, we can tailor an international energy response to the Gulf crisis. The international consensus and resolve so aptly demonstrated in the political/military arena should characterize our energy response as well.

5. Circumstances permit us to rely primarily on market mechanisms to resolve the short-term problem; significant government intervention could be counterproductive.

6. In the event of a real oil supply shortage on world markets—which may occur before the year is out if today's military and demand situation persists—the U.S. should consider drawing down its strategic oil stocks, but only in coordination with other IEA countries. A daily drawdown of 2 million barrels a day (mbd)—equally shared by the U.S., Japan, and West Germany—would be adequate to send the appropriate signals to the market, but at the same time not deplete the reserves at an alarming rate.

7. IEA countries that have no stocks to contribute should be required to adopt demand restraint measures that would yield comparable savings. Together these measures would reduce demands on world oil supplies by 3-4 mbd, which would cover the most likely oil supply disruptions. Finally, IEA countries should commit collectively to avoid "abnormal purchases" on the spot market -- price movements should be influenced by market dynamics, not trader speculation.

8. With world-wide attention focused on energy security, and international consensus at extraordinary levels—now is the time to devise and implement a forward-thinking energy policy that reduces our dependence on unreliable suppliers. Current forecasts, including our own, show that oil imports into the U.S. are likely to increase to as much as 10 to 12 million barrels per day by 2010.

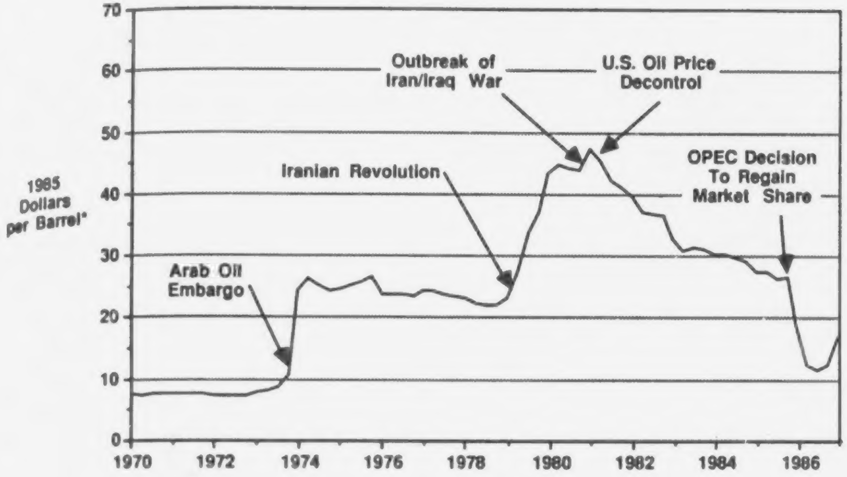
9. Energy policy should be reflective of other national priorities: environmental quality, economic competitiveness, budget realities and national security. To achieve U.S. energy security in the long run, we need to devise a comprehensive energy policy that includes tax incentives for the domestic oil industry, opening of Federal lands offshore and in Alaska for exploration with high regard for the environment, continued support for clean coal technology, stepped-up research renewable energy sources, alternative fuels and nuclear power. But we must emphasize more than supply. Conservation strategies must play a much more important role—in our homes, industry and transportation. We can further reduce our vulnerability to energy supply disruptions by building up our strategic stocks to 1 billion barrels of oil (perhaps by leasing oil from producers) and encouraging other IEA nations to do the same. A reinstatement of the IEA minimum safeguard price should be considered to attract investment to conservation and alternative fuels research.

10. If energy security is not achieved in the coming decade, other important objectives such as the successful transition of the communist world to market economies, economic growth in the Third World, sustained economic success in the U.S., Japan and Europe and the integration of Europe may well be jeopardized. Now is the time to consider energy strategies consistent with broader economic and environmental objectives and develop international policies that ensure our long-term energy future.

HISTORICAL PERSPECTIVE

Since the Early 1970s, Oil Prices Have Reflected International Events

Oil Prices Reflect International Events



* Average quarterly cost of crude oil imported by U.S. refiners.

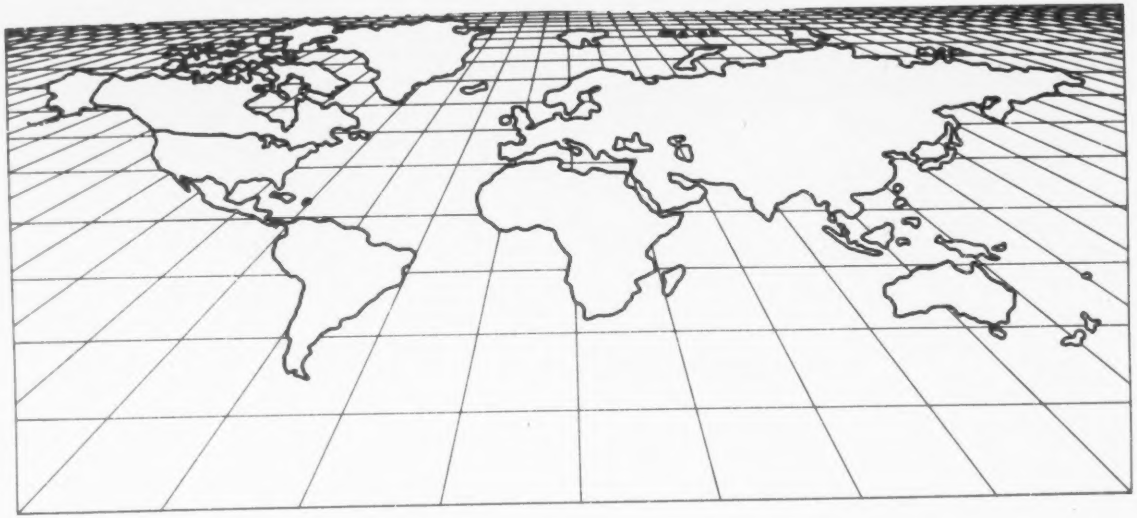
There have been several threatening situations over the last twenty years in the world oil market.

- Today's situation is a reminder of the serious problems the U.S. and other OECD countries encountered in the 1970s and 1980s in securing adequate oil supplies. Revolution, war and a politically-inspired embargo resulted in several major supply disruptions that sent prices sky-rocketing and wreaked havoc on international oil markets in 1973-74 and 1979-80. However, faced with the Iran/Iraq war in late 1980, which escalated to a tanker war, the IEA/OECD responded more effectively and price disruptions were minimized. These experiences have demonstrated what might happen when oil supplies are threatened and what approaches are most effective in dealing with the problem.

- At the outbreak of the Arab-Israeli War in the fall of 1973, member countries of the Organization of Arab Petroleum Exporting Countries (OAPEC) imposed an oil embargo against selected countries—including the U.S.—to retaliate for support to Israel; they also cut back on total production. Although the overall cutback was as high as 3 to 4 million barrels a day (mbd), the average net supply disruption over a 6-month period was about 1.5 mbd. As a result of the cutback in production, prices on the world market tripled from $4 a barrel to more than $12 a barrel. During this time there was no mechanism for international coordination and individual oil companies were left to "go it alone" and scramble for supplies in a tightening market.

- Oil consuming countries learned two very important lessons from the 1973 experience: *international oil markets are extremely interdependent*—a loss of supply anywhere in the world affects prices for all nations; and *energy could be used effectively as a political weapon* especially if the world was caught unprepared. Emergency planning procedures were needed to limit vulnerability to these tactics. Also, government efforts to control prices and allocate oil supplies were unsuccessful and led to confusion, tightening supplies and consumer hardship. Allowing market forces to allocate worldwide and domestic supplies and set prices kept world oil markets in equilibrium and minimized price increases. These conclusions argued strongly for international cooperation in dealing with oil disruptions and, as a result, the International Energy Agency was established in 1974 to assist its twenty-one member countries in developing coordinated mechanisms to limit oil disruptions in the future.

- The next major supply disruption episode was precipitated by the Iranian Revolution in 1978-79 which eliminated up to 6 mbd from Iran's average production. Other oil producing countries stepped-up production to help cover this shortfall, but there was still a net supply loss to the world market of 2-2.5 mbd for six months. In response, the IEA called for 5% voluntary reduction in consumption which was supplemented by country-specific oil import targets devised at the Tokyo Summit. This action was insufficient to calm fears of a serious, prolonged shortage and nations scrambled for oil. As a result of this frantic buying, prices sky-rocketed from $14 a barrel to well over $30 a barrel. The lesson was clear: left unchecked, uncertainty about future oil supplies leads to "panic buying" exacerbating an already-tightening world market.



We learned some difficult lessons in the 1970s which were applied successfully to the crises in the 1980s.

- In 1980, war broke out between two major Gulf oil suppliers: Iran and Iraq. Remembering 1979, IEA countries called for specific measures to lower stocks and avoid "abnormal highly-priced purchases" on spot market. This action was effective— prices increased only marginally ($4 a barrel) and quickly dropped back to previous levels.

- In 1984, escalating hostilities between Iran and Iraq resulted in the beginning of a tanker war in the Persian Gulf. A coordinated international response including countries' willingness to drawdown stocks if necessary, combined with U.S. military muscle that protected the free flow of oil in the Gulf, and sufficient excess oil capacity worldwide to cover potential shortfalls, reassured the market and price increases were minimized. President Reagan announced his attention to tap the SPR if needed and the IEA agreed upon a coordinated stock drawdown policy. Largely as a result of this action, these attacks ultimately had little noticeable impact on the world oil market.

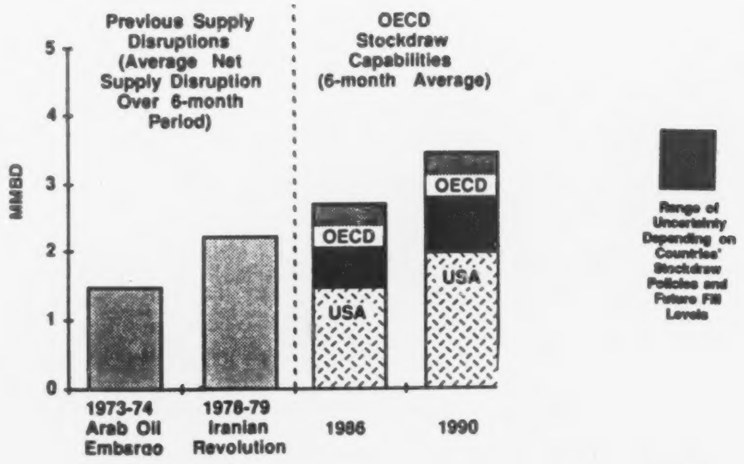
- The final major event in world oil markets in the 1980s was the price collapse of 1986 that persisted until earlier this year. Excess production by OPEC countries, and conservation and fuel switching actions spawned by earlier price hikes and shortages, created a situation where there was an oil "glut." Oversupply exerted downward pressure on prices, which dropped from $24.09 a barrel in 1985 (average annual price) to $12.45 in 1986.

President Reagan's *Energy Security* study in 1987 warned that lower prices would encourage greater dependency on oil — increasing our vulnerability to future disruptions—and encouraged action to counter that trend; nevertheless, attention to energy security matters dwindled in those days of cheap, plentiful fuel. And for good reason. Lower-priced oil was a boon for the U.S. and world economy — inflation was low and the 1980s decade represented the longest period of economic growth in the post-World War II period, due in no small part to lower oil prices. Nevertheless, our energy industry was hurt badly —drilling dropped, conservation slowed and development of alternatives was hampered due to low oil prices.

As we entered the late 1980s, a sense of complacency regarding energy supply issues emerged in many consuming countries as energy policy became driven by environmental and fiscal — not security — concerns. Attention to environmental matters is a top priority in all nations, including the United States, but policies appeared to be tilting too far in favor of environmental quality, at a cost of energy security.

- Saddam Hussein's invasion of Kuwait on August 2 altered this situation, perhaps forever, by reminding us our vulnerability had not disappeared and, for the U.S. and other countries, had actually grown worse. Overnight, an oil glut was transformed into an impending oil shortage, and energy security was thrust back to the top of the global agenda.

Emergency Stocks Provide an Effective First Line of Defense Against Oil Disruptions



The crises of the 1970s and 1980s have left us better prepared to deal with energy emergencies, but there could be the temptation to "go it alone" by many countries.

- Our understanding of oil markets has improved as a result of painful oil disruptions, yielding information we can put to use in grappling with today's problems. In particular, we learned that :

  —Relatively small supply disruptions can result in large price increases. The oil shocks in 1973 and 1978-79 reduced the world oil supply by less than 5%, yet prices skyrocketed in both situations.

  —Oil markets are highly interdependent. Oil is a fungible commodity; thus, a shortage in one country affects prices around the globe. Likewise, if one country releases stocks, prices are reduced everywhere.

  —Reliance on market forces is the superior method of price determination and oil allocation. Government efforts to establish price controls and dictate allocation patterns, including those imposed by the U.S. in the late 1970s, exacerbated supply problems and compounded consumer hardship.

- These previous energy emergencies had serious economic repercussions, and countries have worked diligently to reduce their vulnerability to future disruptions. Progress was made on a number of fronts that enhanced our capability to respond to energy emergencies, including:

  —The IEA was established to provide the mechanism and procedures to organize a coordinated response to minimize the effects of oil supply disruptions. A central feature of the IEA is its emergency sharing mechanism which can be triggered if there is an oil shortfall of 7%. The IEA has never triggered the system, preferring to rely on market forces. Nevertheless, it represents an important "last resort" option which can also serve as a useful deterrent to politically motivated cutoffs of oil.

  —Strategic stocks were significantly increased, helping to offset the danger of dependence on imported oil. At the time of the 1973 oil crisis, government stocks were practically non-existent. Currently, government-controlled stocks in IEA countries cover 151 days of net oil imports, providing some "breathing room" to resolve short-term production shortfalls.

  —Oil price increases spurred major efforts to reduce oil consumption and use energy more efficiently. Significant developments include substitution of alternative fuels for oil in generating electricity (in the U.S., since 1970 oil's share of the utility market dropped from 11.4% to 5.7%), advances in technology that provided sizeable energy-productivity improvements in industry consumption and the transportation sector, and improvements in home construction that dramatically decreased household energy consumption.

  —High oil prices encouraged new oil production in countries in North and South America, Asia, Europe and the Soviet Union, resulting in a reduction in OPEC's market share (and leverage). However, the price collapse of the last three years has discouraged new exploration and many fields in the OECD region are depleting at an alarming rate.

OPEC CRUDE OIL PRODUCTION AND CAPACITY

Country	OPEC Quota	Capacity Available in 1 month	in 3 months
Saudi Arabia	5.38 mbd	7.0 mbd	7.5-8.0 mbd
Iran	3.14 mbd	3.2 mbd	3.3 mbd
Iraq	3.14 mbd	(3.5 mbd)	(3.5 mbd)
UAE	1.50 mbd	2.2 mbd	2.2 mbd
Kuwait	1.50 mbd	(2.0 mbd)	(2.3 mbd)
Qatar	.37 mbd	.5 mbd	.5 mbd
Nigeria	1.61 mbd	1.9 mbd	2.0 mbd
Libya	1.23 mbd	1.4 mbd	1.5 mbd
Algeria	.83 mbd	.8 mbd	.8 mbd
Gabon	.2 mbd	.3 mbd	.3 mbd
Venezuela	1.95 mbd	2.4 mbd	2.5 mbd
Ecuador	.28 mbd	.3 mbd	.3 mbd
indonesia	1.37 mbd	1.3 mbd	1.4 mbd
TOTAL CRUDE OIL	**22.49 mbd**	**21.4 mbd**	**22.8-23.3 mbd**

Today's oil market situation is serious, but containable.

- Oil markets in the first half of this year continued to be characterized by oversupply, and oil prices fell to their lowest real price in a decade. OPEC struggled to drive up prices by imposing quotas that would reduce production and minimize member countries "cheating." In particular, Iran and Iraq—struggling to rebuild their economies under a mountain of war-induced debt and destruction—were desperate to raise oil revenues through a price increase. On July 17, Saddam Hussein of Iraq accused neighboring states (specifically, Kuwait and the UAE) of exceeding OPEC oil-production quotas and threatened retaliatory action. Four days later, Iraq moved tens of thousands of troops to the Kuwaiti border. On August 2, Iraq overwhelmed Kuwait.

- Days after Iraq invaded Kuwait, the UN Security Council unanimously voted to impose an economic embargo against Iraq which prohibited export of Iraqi and Kuwaiti oil, as well as imports of consumer and military goods. As a result, 4 mbd of oil was withdrawn from the world oil market. The most significant customers of Iraqi oil were the U.S. (620,000 barrels/day), Japan (230,000 barrels/day) and Turkey (335,000 barrels/day). Prior to the embargo, the US imported 8% of its oil from Iraq and Kuwait and Japan imported 13.5% of its oil from the two countries.

- Fortunately, both private and strategic stocks are quite high. By summer 1990, *private oil inventories* among IEA countries had reached an eight-year high, and floating stocks were also high. At the end of June worldwide composition of stocks above normal commercial levels were approximately 180 million barrels.

- In addition, there are sizeable *government stocks:* the U.S. Strategic Petroleum Reserve (SPR) holds almost 600 million barrels, West Germany has 190 million barrels and Japan has 175 million barrels. In addition, other IEA countries hold 90 days of imports in government-controlled company stocks. Together, these stocks would cover the major oil consuming nations' total oil imports for 5 months; government stockpiles alone could cover Iraqi and Kuwaiti oil production for over six months.

- Despite these relatively high stock levels, Iraq and Kuwait are major oil suppliers and Iraq's invasion of Kuwait—and the subsequent embargo—fundamentally changes the oil market outlook from one of surplus to one of impending shortages.

- The IEA estimates world demand for oil in the fourth quarter of 1990 will be 55.3 mbd, an increase of 2.7 mbd over third quarter demand due to seasonal factors. We believe that this is a conservative estimate. The ultimate level could be higher if public and private sector oil consumers seek to build excess stocks in light of market uncertainties.

- Other oil producers have stepped up production to meet the shortfall from Iraqi and Kuwaiti production. The IEA estimates Saudi Arabia can increase its production by 2.5 mbd to 8.0 mbd, while Venezuela and UAE—the only two other countries with significant surplus capacity, can increase production for a total of 6.2 mbd. In addition to production capacity, the security of Gulf oil supplies, which could be threatened by military or terrorist action, and consumer demand for oil that has risen in response to concern over future availability of oil, are also critical factors to consider when predicting future oil flows.

A Framework for Action: Making up for Iraqi & Kuwaiti Production

—Stepped up production from OPEC and OECD producers	3 mbd
—Coordinated Drawdown of Government Stocks	4 mbd
—Limited Demand Restraint	1 mbd
—Fuel Switching	1 mbd
TOTAL SAVINGS	**9 mbd**

Tailoring a short term international energy response to the Gulf Crisis.

- Meeting the present crisis requires that we be respectful of the mistakes and progress of the past; at the same time we must recognize that each crisis in the market requires a tailor-made response. The present situation, in my view, is comparable to the setting of 1979. There is uncertainty as to how and when the situation in the Middle East will be resolved. If we are into a period of drawn-out stalemate, then we can expect oil prices to rise gradually based on speculation. In times of market unrest past experience suggests that private companies will hold or build their stocks with the expectation that prices will rise further. This is not unlike consumer behavior when confronted with uncertainty, consumers will tend to fill up more regularly -- thereby keeping their own personal stocks high. In the past we also have learned that markets can be influenced by speculation and rumors. The challenge of governments is to resist undue intervention into the markets; at the same time OECD nations should seek coordinated measures to ensure that price rises or losses are market influenced, not generated by speculation and/or profiteering.

- A major policy question is whether to draw down government strategic stocks in the U.S., Germany and Japan. There are two contrasting views. The first is that stocks should be drawn early in a crisis, thereby reducing the potential for oil price spikes. This strategy seeks to protect the world economy early in a crisis but has the downside that stocks can be used only once and then must be replenished. Also, there might be less incentive for producing countries with available surplus to put their added production on the market, if the OECD countries are lowering their stocks. Another view is that stocks should be used as a last resort. If the military confrontation is prolonged these stocks would be available in potentially desperate situations (such as, for example, restriction of oil flow from Saudi Arabia).

- In his recent decision to test the SPR system, President Bush has made it clear that speculators should not profit unduly from the Gulf situation, and that he is prepared to use the SPR to dampen price speculation or in a situation of a supply shortfall. In the event prices rise to intolerable levels and/or if the projected shortfall on oil supply becomes a reality, a three part international program could be implemented by the IEA:

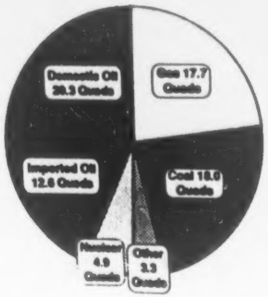
  -- Our first defense is a coordinated draw of strategic stocks. An OECD stock draw of 2 million barrels a day should be adequate to send the appropriate signals t to the market, but at the same time not deplete the reserves at an alarming rate. The U.S. should only consider drawing down its strategic reserves in coordination with other IEA countries. Considering the contribution already provided by the U.S. military—and the U.S.' relatively minimal dependence on Kuwaiti and Iraqi oil—an equitable coordinated drawdown policy could call for Germany, Japan and the U.S. to draw equal amounts, for example 600,000-700,000 barrels per day. Since the U.S. has a larger SPR than either Japan or Germany, this plan would in effect proportionally reduce the U.S. burden, and provide Japan and Germany the opportunity to make a sizeable contribution to the international effort commensurate with their interest in the region.

  -- Second, IEA countries should agree to discourage abnormal purchases on the spot market. This strategy was successfully implemented at the beginning of the Iran-Iraq war in 1980. Nations gave their oil traders notice that abnormally high purchases of oil would not be tolerated and prices remained relatively stable.

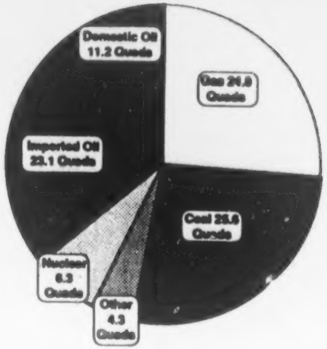
  -- Third, countries that do not have stocks to provide to the world market should be called upon to do their part through demand restraint measures and fuel switching that yield comparable oil supply savings (1.5-2.0 mbd overall).

- Stock draw and demand restraint would reduce demands on world oil supplies by at least 3 million barrels per day which, combined with increased production by OPEC suppliers, would more than adequately cover the most likely oil supply disruptions. Agreement to avoid abnormal purchases would be a strong signal by OECD nations that higher oil prices, brought about primarily by speculation, would not be tolerated.

Oil Imports May Increase Dramatically, Unless Prudent Polices are Adopted



1987 Total Energy Use—76.7 Quads



2010 Projected Energy Use—95.3 Quads

Source: Natural Gas: A Strategic Resource for the Future, Washington Policy & Analysis, November 1988.

Even if we resolve the short term crisis successfully, dangers still exist for future oil markets

- Saddam Hussein's aggression is a stark reminder that we cannot afford to take our energy security for granted, now or in the future. Trends that have increased our vulnerability to oil shocks in the past persist and are seemingly irreversible, including:

—*Oil production outside of OPEC is faltering*. With the exception of OPEC countries, most other major oil producers (U.S., USSR, Mexico) have reached their peak and production from traditional sources has leveled off or is in decline. OPEC's share of the oil market, held in check during periods of high exploration and drilling in the 1980s, is once again on the rise.

—*Oil reserves are concentrated in the Persian Gulf*. The disruption that we are struggling with today focuses on oil production: Hussein is in control of about 8% of current world oil production capacity. A more ominous fact is that 25% of the world's proven oil reserves are in Iraq and Kuwait. In total, 63% of the world's known oil reserves that can be recovered economically with current technology are in the countries surrounding the Persian Gulf. As time goes on, and non-OPEC production continues to decline, our dependence on Persian Gulf oil supplies will grow even stronger.

—*Continued Middle East conflict*. Revolution, wars and other armed hostilities that have affected life in the Middle East for centuries show no signs of abating. In addition to the ongoing Arab-Israeli conflict , the resurgence in Islamic fundamentalism, terrorism sponsored by the PLO, Libya and Syria, the refusal to release Western hostages and the failure of the UN forces to sustain a peace-keeping mission in Lebanon, Saddam Hussein's tactics are a reminder of two new threats to stability and peace in the region: the growing ability of countries to acquire advanced military technology and the rising dissatisfaction over the gap between the "haves" (in Kuwait, Saudi Arabia, UAE) and the "have nots" (in Jordan, Syria, Iraq, Yemen). The Arab-Israeli and Iran-Iraq wars demonstrated that intra-regional conflict can threaten oil supplies and prices around the globe. Future skirmishes could be equally disruptive.

These facts lead foreign policy and energy experts to conclude that the concentration of oil reserves in the world's most unstable region poses a threat to world peace and global prosperity. Pursuing an energy policy that limits our vulnerability to disruptions is a matter of national security and must be a paramount diplomatic objective.

THE GOAL:

Providing for U.S. Energy Security in a Environmentally-Sensitive, Cost-Effective Manner

STRATEGIES:

- Build our strategic oil stocks and encourage IEA countries to do the same.
- Freeze imports at today's levels.
- Reduce harmful power plant emissions.

TACTICS:

- Maintain a strong domestic oil and gas industry.
- Conserve and diversify energy resources.
- Remove regulatory obstacles to efficient energy production and transport.
- Foster international cooperation, including cost-sharing.

The Challenge for the 1990s: Developing a Long-term Plan for Energy Security, Environmental Quality and Economic Competitiveness

- The current spike in oil prices and the potential for an oil supply disruption is currently at the forefront of the energy debate and policymakers are rightfully concerned about how to limit U.S. vulnerability to oil shocks in the future.

- With worldwide public attention focused on energy security, and international cooperation at extraordinary levels, now is the time to be proactive and craft an energy strategy that is economically sound, environmetnally sensitive and politically attractive.

- In order for an energy strategy to be effective and sustainable in the long-term, it must address six sometimes conflicting goals:

  — *Energy Security:* We must lower our oil imports through conservation and development of alternatives.

  — *Environmental Quality:* We must protect our environment in the development and use of energy resources.

  — *Economic Competitiveness:* Jobs and economic growth are central to our national well-being.

  — *Federal Budget Constraints:* Energy incentives and research must recognize the realities of limited domestic spending.

  — *International Energy Security:* U.S. allies and friends have an obligation to themselves and us to reduce their oil dependency.

  — *National Security Concerns:* Our foreign policy must not be held hostage to our need for imported oil.

> "The problem we face is not just an oil problem--it's an energy problem. And it is not just a domestic problem--it is international. We simply cannot view the U.S. in isolation. After all, a barrel of oil or unit of energy saved, produced or stockpiled anywhere is one less barrel that has to be produced in the Persian Gulf."

William F. Martin, Deputy Secretary of Energy
"Energy and National Security: The Past and Future Crisis"
Council on Foreign Relations, Washington, D.C. 4/29/87

A 10-point Plan of Action

- Crafting a balanced energy policy, consistent with other national priorities is a challenging exercise. The following is a list of policy actions -- the pros and cons of which should be debated in the months ahead:

1. Shore up domestic production of oil and gas by providing tax incentives for oil exploration, focusing on field extension and enhanced recovery.

2. Allow further exploration in frontier areas (Alaska) and offshore in an environmentally-sensitive manner.

3. Encourage greater use of natural gas in electrical power plants through more timely FERC approvals of transportation routes and through passage of the Clean Air Act.

4. Reevaluate nuclear power in light over growing concern over the greenhouse effect; encourage research into modular standardized designs, streamline nuclear licensing procedures and ensure that regulation results in high standards of nuclear safety.

5. Maintain market approaches to conservation in households and industry that have helped to achieve impressive efficiency gains over the past decade. Increase federal funding for promising conservation and renewable technologies. Work closely with State Energy Offices -- build a grassroots conseration ethic with more input from the State level.

6. Maintain coal's important position in the U.S. energy mix while protecting the environment by encouraging the development of clean coal technology. DOE's clean coal technology program should be supported, and more rapid deployment of promising technology encouraged.

7. Consider increasing CAFE standards for automobiles, consistent with national economic priorities. Improved fuel efficiency will reduce demand for oil and provide environmental benefits as well.

8. Pursue alternative fuels for transportation -- particularly natural gas-derived fuels such as methanol and electric vehicles.

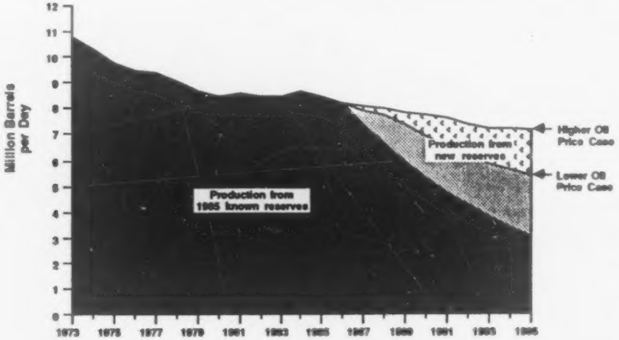
9. Build a 2 billion barrel strategic reserve -- half coming from the United States and half coming from other IEA countries.

10. Consider encouraging the development of alternative energy sources and conservation by reactivating the concept of a minimum safeguard price in the International Energy Agency. The IEA could negotiate an appropriate price, consistent with economic priorities.

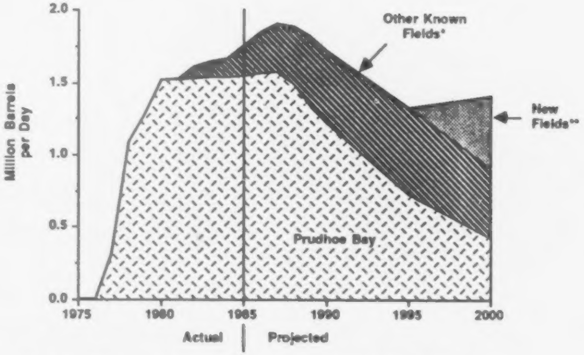
U.S. Oil Production is Declining, but Extensive Reserves Remain

Crude Oil Production From the "Lower 48"

(Includes Natural Gas Liquids)



Alaskan North Slope Oil Production



*Includes Kuparuk, Lisburne, Milne Point, NGL Project, Gwydyr Bay, Point Thompson, Seal Island, and West Sak.

**Includes potential development of the Arctic National Wildlife Refuge (ANWR).

A Competitive U.S. Oil Industry is Vital to Our Energy Security

- Sustained lower oil prices since 1986 inflicted serious damage to the U.S. oil industry. Many "high cost producers" were driven out of business, production dropped, investment plummeted and thousands of skilled oil industry personnel were laid off. Even if oil prices remain high and investment flows back to the domestic oil sector, it will take time for U.S. producers to build our oil infrastructure back to full strength.

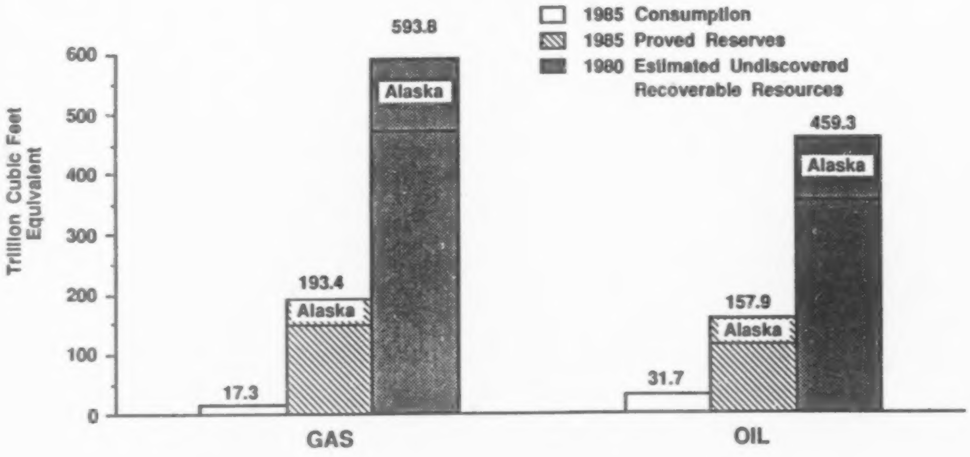
- Primarily because of the collapse in oil prices during 1986, U.S. crude oil and natural gas production declined by 12%over the 1986-89 time period. "Lower 48" production began to decline in 1986-87, and the pace of the decline in the future will depend, in part, on oil prices, government policies, and other factors.

- Our promising reserves lie on federal lands in frontier areas or offshore. ANWR has up to 9.2 billion barrels of recoverable oil, which would support production of about 1.5 mbd. A mean estimate of the undiscovered recoverable oil underlying the Outer Continental Shelf (OCS) is more than 12 billion barrels. Substantially larger amounts of oil and gas may exist beneath the coastal plain of ANWR and the OCS, but its existence can only be verified by exploration.

- High priority should be given building a consensus between the Administration, Congress and important environmental groups as to the future development of domestic reserves in a timely and environmentally sensitive manner. The Congress and Administration should also consider instituting favorable tax treatment for new oil and gas exploration.

Natural Gas is Abundant and Clean and Can Substitute for Imported Oil in Many Applications

U.S. Natural Gas Resources are Comparable to Oil Resources



Source: Energy Information Administration

Natural Gas: A Strategic Resource for the Future

- With abundant worldwide reserves, countries will use gas to reduce dependence on oil and to reduce environmental problems associated with other fossil fuels. Several factors will encourage the use of natural gas for electric power production worldwide, including raised expectations regarding supplies, environmental concerns with coal and nuclear power plants, relaxed restrictions on gas use for electricity production and growing use of gas-fired combined-cycle units to meet future demand and price competitiveness.

- U.S. natural gas resources are large when compared to current domestic gas consumption. At the end of 1989, the U.S. had approximately 168 trillion cubic feet (tcf) of proven reserves, compared with consumption in 1989 of 18.95 tcf.

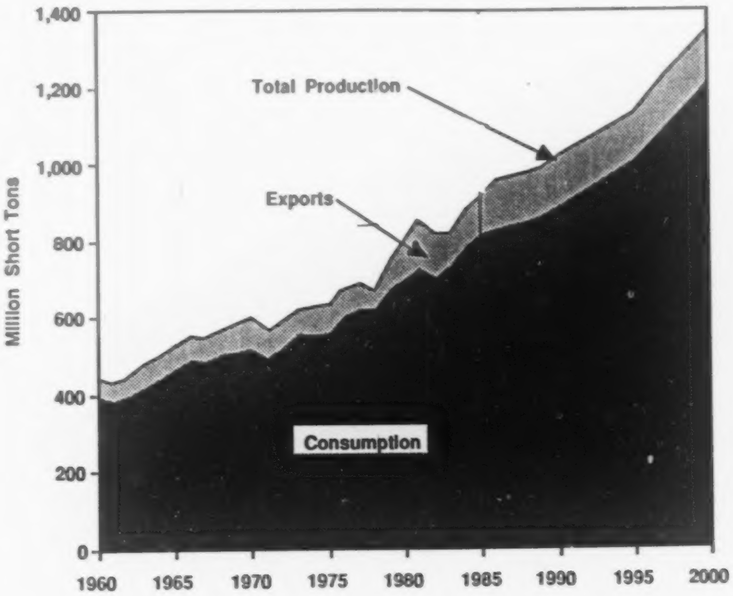
- While the natural gas surplus will diminish as the electric utility industry increases its use, long-term supplies of foreign sources of natural gas are available. There appears to be growing interest among natural gas producers, including Canada, Algeria, Mexico and Norway to increase gas imports into the United States, further enhancing the availability of natural gas.

- Secure supplies of natural gas can replace oil in many applications, thereby freeing up oil supplies for uses in which other fuels cannot substitute. For example, fuel-switchable industrial users can switch from oil to gas almost immediately, electric utility boilers can swtich from oil to gas, new power-plants can use gas-fueled combined-cycle technology, and natural gas can serve as an industrial feedstock in lieu of certain petroleum products. Compressed natural gas vehicles could allow gas to substitute for oil in transportation.

- The removal of price controls in the Natural Gas Wellhead Decontrol Act of 1989 was an important development for the domestic gas industry. However, additional action is needed to address some of the remaining regulatory impediments to an efficient natural gas industry including restricted access to pipelines and end-use restrictions. In my judgement, overregulation of natural gas has stifled its efficient production, transport and use. A freer gas market would benefit consumers, the energy industry and the Nation.

- A combination of regulatory reforms and comprehensive legislation could increase the competitiveness of natural gas, lower prices paid by consumers and reduce U.S. imports. We should move now to take full advantage of natural gas as a strategic resource for our future by funding R&D related to natural gas production and gas-use technologies, allow exploration of onshore and offshore federal lands in an environmentally-sensitive manner, offer limited tax incentives to encourage domestic production, and implement and enforce Clean Air legislation that will promote the use of natural gas while providing environmental and public health benefits.

Actual and Projected U.S. Coal Production



Coal has Substantial Potential to Limit Dependence on Imported Oil in an environmentally sound manner

- Coal is our most abundant fossil fuel resource, and the U.S. has the industrialized world's largest coal reserves. Since the energy shocks of 1973, coal has increased its share of total U.S. energy consumption from 18% to over 23% in 1989.

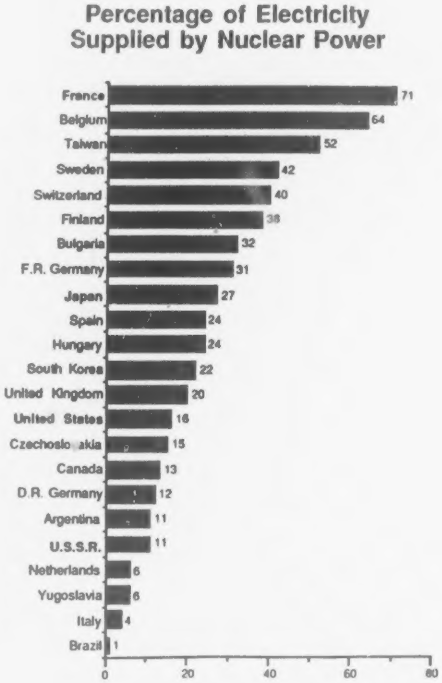
- The challenge to coal is to burn it cleanly. Significant progress has been made in reducing harmful emissions over the last decade, but further progress is required to satisfy the public's demands for cleaner air. The Clean Air Act, as submitted by President Bush and endorsed by many in Congress, will encourage the continued use of coal in an environmentally sensitive manner.

- At the same time, we must continue efforts to fully understand the impact of CO2 burning on the greenhouse effect. There are still considerable scientific uncertainties about the relationship of the greenhouse effect and global warming, but there is sufficient concern to warrant intensified scientific inquiry. The International Panel on Climate Change is playing a useful international role in determining the scientific basis of global warming and at the same time considering potential policy responses, consistent with economic priorities.

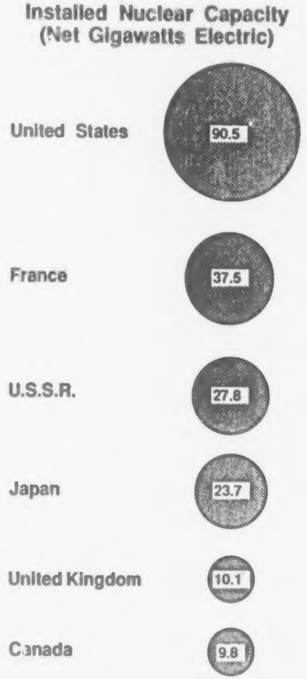
- In today's environment of oil shortage, we have few short term alternatives to substitute for coal in electrical generation. Coal meets almost 60% of our electricity needs and to forego even a small percentage would be difficult and probably result in greater oil use. At the same time we must be respectful of environmental priorities. Our best option at the moment is to continue funding for DOE's Clean Coal Technology Program -- an innovative program which invites a useful government-industry partnership. Once these technologies are developed, we should examine regulatory means to deploy them more rapidly.

- Finally, the Administration should support a strong coal export program. Over the last decade the U.S. coal and transportation industries have improved their competitive position and are well situated to expand coal exports to the Pacific and the Europe. At the moment, however, some European nations presently subsidize their highly unprofitable coal industries. Such subsidies go against the spirit of free trade and should be eliminated, thereby paving the way for greater imports of competitively priced U.S. coal.

Nuclear Power Plays an Important Role Worldwide, but Problems Remain



Percentage of Electricity Supplied by Nuclear Power



Installed Nuclear Capacity (Net Gigawatts Electric)

Nuclear power deserves another look in light of energy security and environmental concerns

- The over one hundred nuclear power plants in the United States today supply some over 15% of U.S. electrical needs. As we look toward the future nuclear power can help improve energy security and enhance environmental quality. At the same time, nuclear power's future is likely to depend upon whether three conditions can be satisfied:

  -- Nuclear power should be able to compete with other sources of electricity supply in the marketplace on its economic merits, as it did in the United States in the early 1970's and as it does in many other countries now.

  -- The safety of existing and future nuclear power plants must continue to be satisfactorily demonstrated, so that general public acceptance is restored.

  -- Progress must be evident in the siting and building of high-level waste-management systems in a safe and publicly acceptable manner. Recent court rulings allowing a feasiblity study of Yucca Mountain, Nevada, as a potential site represents some real progress in this area.

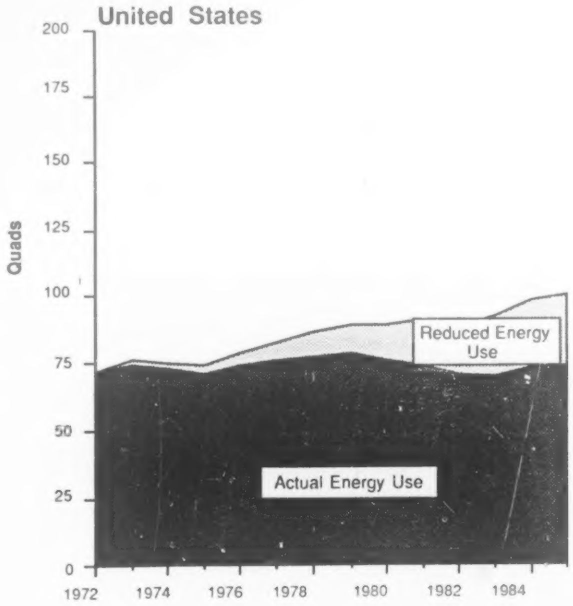
- In the United States, utilities will be unlikely to order new plants until several interrelated issues are satisfactorily resolved. These include:

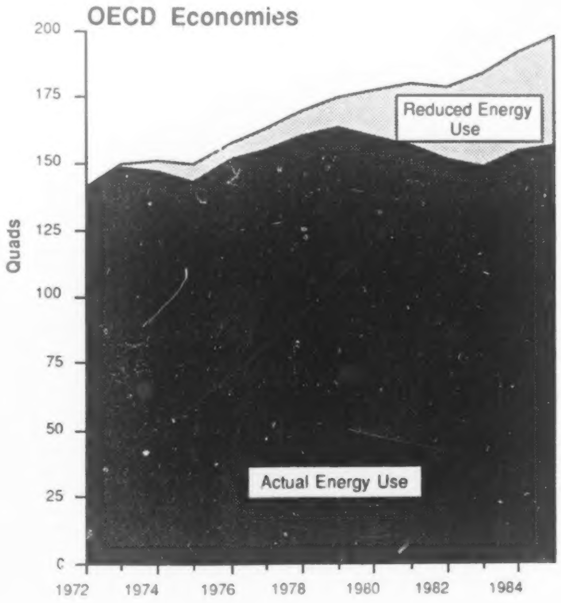
  -- Establishment of an appropriate balance between prospective risks and prospective rewards for utilities that invest in new capital-intensive generation.

  -- Continued forward progress in the deployment of satisfactory waste-management systems.

  -- True "one stop" licensing that removes the likelihood that a license will be denied after a sizeable investment has been made in plant construction.

We've Made Significant Progress in Energy Efficiency, but Transportation Remains Heavily Dependent on Oil





Energy efficiency , alternative fuels for transportation and renewable energy resources improve energy security and environmental quality.

- Today, the United States uses virtually no more energy (and less oil) than it did in 1973 -- although its population is still expanding and the Nation continues to turn out more products and services. Without the improvements in energy productivity that have taken place since 1973, the United States would now require the equivalent of about 14 million more barrels of oil every day.

- Advances in technology have accounted for two-thirds of the recent energy-productivity improvements in U.S. industry and three-fourths of those in transportation—resulting in more product output per energy unit and more miles per gallon. Energy efficiency has also improved in other OECD countries. Higher energy prices should continue to encourage greater conservation -- which helps both energy security and environmental objectives.

- The most heavily oil dependent sector remains transportation. *U.S. transportation uses more oil each year than we produce*, accounting for more than 62 percent of all oil use. Therefore continued priority should be given to improving automobile efficiency standards, as well as in encouraging greater use of alternative fuels such as natural gas derived fuels (such as methanol) and electric vehicles.

- The majority of *renewable energy* used in the world now comes from large hydroelectric plants and wood fuel. Hydroelectric plants provide 20 percent of all electricity, or 8 percent of total free-world energy use. But, current conventional renewable energy has a relatively slight growth potential. Most large hydro resources have been developed, and dispersed woodburning is not expected to increase significantly since less developed countries will use more oil, gas, and electricity for heating and cooking.

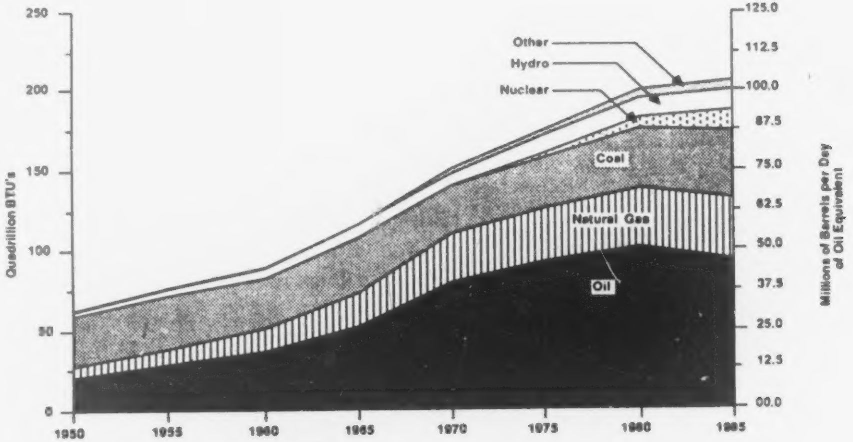
- The United States and the world will, in time, rely largely on essentially inexhaustible energy sources, including many diverse sources such as solar, wind, geothermal, water, and biomass energy. Achieving renewable energy's potential requires a far-sighted effort to improve the cost and performance of renewable energy. Improvements in the cost and performance of these technologies or a sustained increase in the price of oil and other alternative fuels will increase the cost competitiveness of these energy sources.

- The approach to achieving renewable energy's potential contribution is through a realistic, far-sighted effort to improve the technology base from which private enterprise can make development and investment decisions. Competition with more conventional energy resources, as well as among the technological approaches for renewable energy, will ultimately determine how much of this country's energy needs each technology will satisfy.

CONCLUSIONS

Dependence on Imported Oil is A Global Problem and Requires a Global Solution

Global Energy Use, 1950-1985*



*Excludes centrally planned economies

Source: U.S. Energy Information Administration, United Nations,
Shell Briefing Service

The U.S. cannot "go it alone." All nations must reduce reliance on Gulf oil.

In addition to efforts undertaken by the U.S. and other individual countries to limit their vulnerability to energy disruptions, coordinated international energy action can make important contributions to global energy security. A nuclear power plant in Japan, a clean-coal generation project in Italy, a geothermal project in Central America or a hydropower plant in China all serve to reduce world demand for oil—and all countries reap the benefits. Important alternatives include:

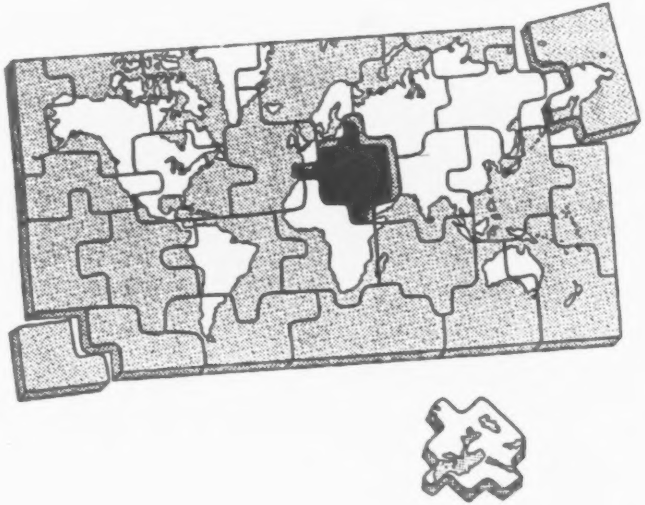
- *Coal*—which has increasingly been used as a substitute for oil in generating electricity in the U.S., Japan and other countries—can be expanded further to reduce oil consumption in the utility sector. Currently, concern over the relatively high environmental costs associated with coal burning has limited the appeal of this important and abundant fuel. However, clean coal technology research in the U.S. and Japan has yielded some promising developments, which will enable coal to be burned more cleanly in the future. Expanded international trade in steam coal can help lower energy costs in coal-importing countries. Effort should be made to reduce local subsidies (particularly in Germany, the UK and Belgium) which raise costs and lower economic efficiency.

- The future outlook for *natural gas* is bright. We predict that the environmentally superior attributes of natural gas—and its abundant worldwide reserves and relative low price—will make natural gas the world's fastest growing fossil fuel in the next two decades. Many countries are expressing interest in expanding consumption of natural gas—stepped up production in the North Sea, Alaska, the Pacific and USSR would help ensure supplies that could keep pace with demand. European efforts to deploy timely investment in gas infrastructure and diversify gas supplies would contribute to a more secure supply of natural gas in the years to come.

- *Nuclear power has been a major contributor to reducing major energ*y consumers reliance on imported oil (including the U.S., France and Japan) in the utility sector, and continued or expanded use could extend these benefits further. Public opposition remains a constraint to further development of nuclear power, but new, more modular and standardized designs may help nuclear energy regain its momentum. International efforts to develop the new generation of "inherently safe" reactor technology, establish efficient and safe procedures for nuclear waste disposal, and enforce stringent international public safety standards when operating nuclear power plants—particularly in developing countries and the Soviet Union—could go a long way in reassuring the public about nuclear power and protect its position in a diversified global energy portfolio.

- *Finding substitutes for oil in the transportation area* offer promise for the future and provide security benefits by reducing dependence on oil; international research collaboration could help bring these technologies to market in a timely, cost-effective manner. Non-oil-based transportation fuels offer special promise in this regard, since so much of the world's oil consumption is devoted to the transportation sector. International research programs on effective, economic conversion technologies for non-petroleum transportation fuels such as electric vehicles, solar power autos, and natural gas-based fuels such as methanol could go a long way toward realizing the potential contribution of renewable resources to worldwide energy security.

- *Conservation technologies*. Largely as a result of significant advances in transportation technologies and residential construction designs that did not adversely affect consumers' lifestyles, OECD countries consumed slightly less oil in 1989 than in 1970, despite significant economic growth during this period. Future breakthroughs in conservation technologies could help maintain this significant progress.



Conclusion — finding the balance between energy security, environment and economic competitiveness.

- There has been a growing awareness in the past few years that the environment is a global responsibility. Water and air pollution, acid rain, "greenhouse gases" and nuclear radiation know no national borders and a consensus has emerged that the global nature of these problems dictates a global response.

- These arguments are equally compelling for energy security policy: interconnected world markets require an international approach. Efforts to "go it alone" and ignore the international process are not only inefficient from a market perspective, but can result in creating conflict among consuming nations that could damage overall bilateral relationships including security alliances, trading relationships, cultural exchanges etc.

- Finally, policymakers must strive to achieve a balance between three critical objectives: economic competitiveness, energy security, and environmental quality. While some policies may be consistent with all three goals, others may not. Together we must seek solutions including reconciliation of conflicting objectives of efficient energy consumption with the need for reliable energy sources and concern over public safety. The events of the past few weeks have demonstrated that we cannot forget the security aspect of energy policy, even during periods when oil is cheap and plentiful.

- If energy security is not achieved in the coming decade, other important objectives such as the successful transition of the communist world to market economies, economic growth in the Third World and in industrialized countries, and the integration of Europe may well be jeopardized. Now is the time to consider energy strategies consistent with broader economic and environmental objectives and to develop international policies that ensure our long-term energy future.

Senator **Bingaman**. Thank you very much. Our final witness on this panel is Henry Schuler, who is the holder of the Dewey F. Bartlett Chair in Energy Security Studies at the Center for Strategic and International Studies here in Washington.

Before joining CSIS, Henry Schuler had extensive experience in the international oil industry, including the development and management of projects in the Middle East and the North Sea.

Mr. Schuler, thank you for being here.

STATEMENT OF G. HENRY M. SCHULER, DIRECTOR, ENERGY SECURITY PROGRAM, CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES

Mr. **Schuler**. Thank you, Mr. Chairman. Senator Ford, I hope you are not going to regret your advice to us to be blunt and candid because I am going to be precisely that.

Senator **Ford**. I would like to, you know, you can speak in four-letter words. I am bilingual, bad English and Southern, and so understand that when you start talking to me.

Mr. **Schuler**. Well, we all learned to understand that southern English during the recent television series and to respect it very much.

I intend to be candid to the point of being contrary, precisely because I think it is important to, if we are to maintain a long-term concern and perspective on this oil situation, we need to recognize the facts, the brutal facts as they exist in the Gulf today and for the foreseeable future.

In my judgment, the administration's belated focus upon the risks to Middle Eastern oil places too much emphasis on who controls the valve and not enough on where the valves are located.

This focus is not only invalid, but dangerous because it creates the impression that if we can only get rid of Saddam, if we can restore the al-Sabahs, if we can prop up the al-Sauds, then we do not need to worry about dependence upon Middle Eastern oil.

I suggest that that is invalid as well as dangerous and the invalidity is proved by the situation that existed during the 1970's. Our oil price shocks in the 1970's did not come from a concentration of power in a single set of hostile hands, but rather from the problems endemic to the region.

The first oil price explosion, which was a doubling of oil prices between September of 1969 and February of 1971, was due not to a consolidation of power in a single set of hands, but in fact to the fragmentation of oil production and pricing decisions.

What happened was a set of leapfrogging that took place because each government felt compelled to build a higher price on the base, on the floor, that the neighboring government had gone through. This reached the point that the United States and the OECD countries, both as governments and as oil companies, deliberately sought a consolidation of power in the negotiations in Tehran in February of 1971.

Those were abortive, but they demonstrate that this notion, that concentration of power is the only source of oil shocks is wrong.

Secondly, with respect to the hostility in the hands that control those valves, I would remind you that the quadrupling of oil prices at the end of 1973 was not due to the fact that they were controlled by a hostile set of hands, but rather by our most staunch friend in the Middle East, King Faisal, who reduced output, Saudi output, by 25 percent in response to domestic pressures that emerged out of the Arab-Israeli war.

I emphasize the "where" rather than the "who" because the Middle East is a very fragile area racked by innumerable disputes: Palestinians who have been thoroughly radicalized by Israel's right wing politicians; feudal governments and oppressive regimes that lack the stability of institutionalized popular mandate or even rudimentary political participation; an abundance of ethnic, cultural, religious, racial, sectarian, regional, and tribal strains throughout the region; enormous income disparities both at the national and the individual levels; millions who are turning inward to Islam after decades of frustration in reaching outward for identity in inapplicable non-Moslem systems; and, finally, endless border disputes.

Anybody who thinks that the Kuwait-Iraq border dispute is the only one in the area fails to recognize that countries throughout the region as a result of their colonial heritage have border disputes. Within the past 12 months we have had Qatar and Bahrain, for example, at swords' points over a border dispute.

Now, until recently I thought or at least hoped that the exporters of the region could keep the lid on these problems. I am now convinced, however, that the massive deployment of the U.S. ground force and the possibility, and some days I think probability, that that ground force will be used will unleash hostile forces that we cannot now identify, much less control.

I am convinced, therefore, more than ever that we must pursue a two-path approach. First, we must reduce our requirements for oil imports by encouraging energy efficiency investments, natural gas substitution, clean coal, research and development, nuclear power, frontier drilling, all of the options that we can fulfill in this country to reduce the need for imports.

Beyond that, I believe that we can slow the growth in imports but I do not believe we can reverse it. So the second path that I would urge we pursue which has been alluded to by others here today is that we encourage development of oil exports outside of the Middle East, especially in the western hemisphere.

While there are a number of western hemisphere prospects, I will focus my attention on Venezuela. I do so because Venezuela has an enormous resource base. Its proved reserves are, for example, 10 times the proved oil reserves of Canada. Secondly, it has a commercially motivated oil industry that seems to me more responsive to U.S. oil market opportunities than Mexico's national oil company.

Venezuela, just to run through some of the situations and the opportunities and promise that Venezuela holds, I would note that Venezuela is currently the provider of 12 percent of U.S. oil imports during the first half of 1990. Its proved reserves are 59 billion barrels of conventional oil. That is light and medium oil. This is twice the reserves in the United States, as I say, 10 times those of Canada which are 6 billion, and slightly greater than the reported reserves of Mexico which are 56 billion.

These already proved reserves are currently supporting 2.3 million barrels per day of Venezuelan production, and I would emphasize that 300,000 barrels per day of that has been added since August 2 and the Iraqi occupation of Kuwait. Venezuela plans to increase its crude production to 2.5 million barrels per day by the end of the year.

As the destination of two-thirds of Venezuelan crude and product imports, the United States is the major recipient of Venezuela's base production and, of course, of its supplemental production. I would note in this regard that we become the beneficiary of Venezuelan investments during the lean recent years that maintained a production capacity in excess of what could be produced and marketed at the time. This is unlike the situation in Mexico, unlike the situation in all but two other Middle Eastern exporting countries, Saudi Arabia and the United Arab Emirates.

Venezuela's oil links to the United States—and this, I think, is very important because I think it emphasizes the commercial nature of this Venezuelan industry—include investments in 0.5 million barrels per day of refining capacity in this country. That is refining capacity that they obviously have every intention of keeping supplied with crude oil at a bare minimum because the refinery investment is worthless if the crude oil is not provided.

The potential for expanding the oil links is unrivaled in the western hemisphere. Venezuela expects to prove up an additional 62 billion barrels of light and medium crude oil, and this was an expectation prior to the current price explosion.

So there is conventional crude oil resource base that is yet to be proved up, and there is a massive unconventional base of liquid hydrocarbons. It is estimated that the Orinoco Heavy Oil Belt contains 1.2 trillion barrels of oil in place. This is heavy oil 10 degrees gravity and lower. Using a conservative recovery factor of 25 percent, it is estimated that 267 billion barrels of that are now recoverable with current technology. This heavy oil is already being marketed in the United States as a direct boiler fuel. It is a process that they call emulsion where they mix it with water in an emulsifier and burn it directly in boilers.

Even more important than that is the long-term potential for turning this heavy oil into the light products that we require for the transportation system, and that is possible, the Venezuelans feel, with additional research and a massive amount of investment in a process that they call HDH, which is a catalytic hydroconversion process for turning the heavy oil into a synthetic oil of 40 degrees gravity which can then be either blended into the other crude oil stream to lighten the stream or further processed into refined products.

Now as we all have learned in the synthetic fuels effort in this country, these target numbers tend to be elusive; but on the basis of a 5-year operation of a pilot plant in Germany and engineering plans for a 15,000-barrel-per-day plant which can use conventional standard equipment, the Venezuelans estimate that at prices of $25 to $30 per barrel, world oil prices of $25 to $30 per barrel, they can convert this huge resource into transportation fuels. If so, the Orinoco Belt offers, as I say, an unrivaled opportunity for the world and especially for the United States to reduce its dependence upon Middle Eastern oil for transportation fuel.

Many challenges remain, and at this point I guess the most important suggestion I would have is that I think that Venezuelan and American industry can meet the capital and technology requirements to develop this resource, but everybody has to be assured that if this investment is made it is not going to be barred from the United States market either by some sort of an oil import fee that applies across the board or by some sort of investment restrictions in the United States, all things that have surfaced in debate within Congress.

Thank you.

[The prepared statement of Mr. Schuler follows:]

PREPARED STATEMENT OF G. HENRY M. SCHULER, DIRECTOR, ENERGY SECURITY PROGRAM, CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES

In attempting to identify America's vital interests in the Persian Gulf, President Bush has emphasized that we cannot permit one man, Saddam Hussein, to control—through annexation or intimidation—that region's vital oil supply valves. That formulation reflects four underlying assumptions, two of which are entirely valid and two of which are highly dubious.

The formulation is correct in emphasizing the importance of the region's oil valves:

America's principal interest—some would say "only" interest—in the area arises out of Middle Eastern domination of world oil trade. Prior to the crisis, the fifteen exporters of the Middle East and North Africa accounted for over half of the world's imports; over three-quarters of the world's unutilized production capacity; and over two-thirds of the world's recoverable reserves.

The principal threat to American interests is, therefore, the risk that such domination will be used to impose an unexpected oil price shock. While that risk is, of course, economic—rising inflation, reduced economic growth, greater unemployment, stock market collapse, dollar devaluation, interest rate constraints, rising bankruptcies—it is so pervasive as to threaten the fundamental underpinnings of American power.

Although the formulation is correct in emphasizing the American interests and risks associated with the location of the world's most important oil valves, it ventures onto much more shaky ground when it focuses upon the identity of the individual/regime that controls those valves. Such focus reflects two additional assumptions:

It assumes that a fragmentation of control over Middle Eastern oil valves will serve as a barrier to oil price shocks; and,

It assumes that preserving "friendly" control over those valves will provide additional insurance against such price shocks.

While Iraq's domination of additional valves on the oil-rich Arabian Peninsula would certainly alter the strategic, political and military balance within the region, it is much less clear that the consolidation of such control in unfriendly hands would heighten the risk of oil shocks within a wider international context. In fact, analysis of the oil situation during the 1970s demonstrates that both fragmentation and "friendly" (but insecure) control of the valves have been the direct cause of several price shocks.

The first oil shock, a doubling of world oil prices between 1969 and 1971, was caused by fragmented producer governments competing to "one-up" their neighbors. It began in Libya when Muammar Qadhafi celebrated the first anniversary of his September 1, 1969 coup d'etat by forcing the multinational oil companies to accept price increases that were unprecedented in their day. Instead of accepting that Libya had a very special set of claims arising out of the quality and location of its oil, rival exporters—radicals and moderates alike—refused to be upstaged by a 28 year old army lieutenant who knew nothing about oil markets, and imposed unilateral increases of their own. Because oil production and pricing decisions were fragmented, each government was inspired—or goaded—to use his neighbor's new price floor as a springboard to leap even higher. By January 1971, this price "leap frogging" or "ratcheting" had gotten so far out of hand, that President Nixon, with the support of most Western governments and virtually all of the world's oil companies operating in the Middle East, urged the Shah of Iran to assert leadership over the Persian Gulf producing countries to establish a collective price. The shah ultimately secured the support of his Saudi, Kuwaiti and Iraqi neighbors for a new five year contract at a price which doubled world oil costs but soon failed to satisfy exporters. Still, anything seemed preferable to open-ended "leap frogging".

The second oil shock, a quadrupling of oil prices between September 1973 and January 1974, was initiated by Saudi King Feisal, a strong leader and staunch friend of the United States who had repeatedly denied the utility of using oil policy as a potential weapon in the Arab-Israeli conflict. Fearful that the Saudi army would mutiny if he failed to use the Kingdom's oil leverage after outbreak of the October 1973 war, King Feisal abandoned his convictions and decreed that Saudi production be progressively reduced on a schedule that ultimately removed over 2 million barrels per day from world oil markets (27 percent of Saudi Arabia's September 1973 production.) Taking their lead from Feisal, other Arab leaders—with the ironic exception of Iraq's Saddam Hussein—followed suit, removing a total of about 4.5 million barrels per day during the December peak of the pressure campaign. Although non-Arab producers, principally Iran and Venezuela, made up for some of that loss, panic exaggerated the physical shortage, causing a four-fold increase in oil prices.

These experiences of the 1970s should prompt us to ask whether we are attaching too much importance to the transient identity of the valve master when the more enduring problem is the location of the valves! If so, preservation of the Houses of Saud and Sabah and elimination of Saddam Hussein—whether political or physical—will not long guarantee the world's access to secure supplies of Middle Eastern oil at reasonable prices.

The Middle East is plagued by numerous tensions, which may—singly or in combination—explode at any time:

The Palestinians are thoroughly radicalized by the intransigence of Israeli's Likud politicians.

Neither the feudal monarchies nor the oppressive dictatorships enjoy the stability of an institutionalized popular mandate or political participation.

Ethnic, cultural, religious, racial, sectarian, regional and tribal strains abound.

Income disparities are enormous on both the national and individual levels.

Many millions are turning inward to Islam after decades of frustration in searching outward for identity in the political-economic systems of non-Muslim heritages.

Disputes over imperialist-imposed boundaries abound: Qatar vs. Bahrain, Abu Dhabi vs. Oman, Yemen vs. Saudi Arabia.

As we attempt to assess the future of oil exports from the Middle East, we must ask if an outbreak of military hostilities—or even just the passive deployment of massive American ground forces—can avoid exacerbating those tensions. If not, the U.S. strategy may maintain the status quo for the short term . . . but contribute to instability in the long term!

If this analysis is valid, the United States must pursue a two path energy strategy:

We must try to reduce the growth in oil imports by reassessing the costs and risks of domestic energy alternatives in light of the costs and risks associated with sending a quarter of a million American servicemen to the Middle East. Those alternatives must, of course, include efficiency investments, natural gas substitution, research and development, clean coal technology, nuclear power and frontier exploration.

Because it will be impossible in the medium term—and exceedingly difficult even in the long term—to reverse the rising import trend, we must also encourage the development of crude oil and refined product export capacity outside the Middle East, especially that in the Western Hemisphere.

Since I understand that other members of this panel will spend their time on the domestic options for reducing oil imports, I will focus on what I believe to be the most significant opportunity for increasing Western Hemisphere exports to the United States . . . the enormous liquid hydrocarbon reserves of Venezuela.

Venezuela, already the provider of 12 percent of the U.S. crude and product imports during the first half of 1990, has proved conventional crude oil reserves of 59 billion barrels. For comparative purposes, those reserves are more than twice those of the United States (26 billion), ten times those of Canada (6 billion) and slightly greater than the reported reserves of Mexico (56 billion). These conventional reserves currently support some 2.3 million b/d of crude oil production, including 300,000 b/d that were urgently added to help offset the world boycott of Iraqi and Kuwaiti exports. Venezuela plans to increase crude production to 2.5 million b/d by the end of the year. (NOTE: these figures do not include several hundred thousand b/d of condensate and natural gas liquids.)

As the destination of two-thirds of Venezuelan crude and product exports, the United States is the major recipient of this supplemental production capacity maintained through 1989 investments by Petroleos de Venezuela S.A. (PDVSA) on exploration (20 wildcat wells and over 1,000 miles of seismic); development drilling (182 new wells and 1,058 workovers); and the acquisition of 9.5 million barrels of oil storage facilities on the Bonaire, Netherlands Antilles.

Venezuela's oil links to the United States go beyond crude and product exports, for PDVSA is also the owner of CITGO Petroleum Corporation which will, upon completion of a pending reorganization, operate a 320,000 b/d refinery at Lake Charles, Louisiana and a 120,000 b/d refinery at Corpus Christi, Texas. PDVSA also owns, with Union Oil Company of California, half of a 153,000 b/d refinery in Illinois. Those refinery investments also include associated pipelines, terminals and marketing facilities.

The potential for expanding these oil links is unrivalled in the Western Hemisphere. Venezuela expects to prove-up an additional 62 billion barrels of light and medium oil, but these large reserves of conventional crude oil are dwarfed by the truly staggering reserves of unconventional liquid hydrocarbons. It is estimated that the Orinoco Heavy Oil Belt contains 1.2 trillion barrels of viscous hydrocarbons (10 degrees API or less). Using a conservative recovery factor of 25 percent, an estimated 267 billion barrels are now recoverable with current technology.

This heavy oil is already being marketed as a direct burning boiler fuel under the trade mark Orimulsion (70% oil and 30% water, with an emulsifier.) Since the Orinoco oil's producing and transportation challenges have already been met, PDVSA has turned its research to the refining challenge. This had led to the development of a catalytic hydroconversion process which it calls HDH. Through the addition of hydrogen to the heavy oil, HDH produces a 40 degree API synthetic crude that can be further processed or blended into a conventional crude stream.

On the basis of 5 years operation of a pilot plant and engineering plans for a 15,000 b/d plant capable of being built with standard equipment, PDVSA estimates that the HDH process is commercially viable with conventional oil in the $25-30 price range. If so, the Orinoco Oil Belt offers an unrivalled opportunity for the world—and especially the United States to reduce its dependence upon Middle Eastern oil for transportation fuel.

Many challenges remain, but the U.S. must not overlook this enormous resource as it searches for ways to avoid sustained or repeated—deployment of troops in the Middle East. American and Venezuelan companies can, in cooperation, raise the capital and develop the technology, but Congress must make sure that world wide trade tensions do not lead to oil import fees, investment constraints or other punitive measures that could discourage the growing Venezuelan-American energy link.

Senator BINGAMAN. Thank you very much. We have a lot of people here to ask questions. I think what we will try to do is keep the first round of questions to about 6 minutes each. I will start with that, and then if we still have time for additional questions, we will do another round.

Dr. Yergin, let me ask you first, my own sense is that much of the problem we face is a result of the unwillingness—political unwillingness—to step in and interfere with the so-called free market in oil; we have had this debate off and on in the 8 years I have been here in this committee.

I would be interested in your view, and Dr. Gibbons also, as to whether it would make sense, if we are going to actually try to stimulate a shift to alternative fuels and to stimulate a greater amount of domestic production, is there not something we can do to set a minimum price on imported oil, or to do something which would assure people that when this Iraq situation is resolved one way or another, the price does not go back to $12 or $10 a barrel?

In my State, where we produced substantial amounts of oil, or used to, the concern is always, how can you expect us to make an investment in additional production when the price of oil has gone up and down like a yo-yo, depending upon what Saddam Hussein has for breakfast? There has got to be a more rational way, if we are going to deal with this, to send realistic signals to the market over a period of time.

Dr. Yergin, do you have any ideas on that?

Dr. **Yergin**. Yes. I think there is a tendency in this country to want the best of all possible worlds. We want cheap energy, we want secure energy, we want clean energy, and it is hard to do all of them at the same time. Short-term price signals can really be quite confusing, and certainly last spring gasoline prices in real terms were lower than they had been at any time since World War II.

The short-term price signals of 1986–1987 ended up destroying a lot of stripper oil production that will never come back, and I remember some months ago being in Japan, where some Japanese said to me, how could the United States, as a super power, allow this oil production to just disappear like that, when it is a very short-term situation? This is a source of strength for you as a country.

So I think that in some ways the price should be reflecting the reality of the situation. There is clearly a heavy security component, as we can see in the price of oil, which has not really been seen, and we are not going to get the kind of investment that you would like to see in your States that we need. We are not going to be able to slow the decline in production without some clear, economic, longer-term signals that investors and oil people can count on.

Senator **Bingaman**. Dr. Gibbons, did you have a thought as to whether we ought to have a minimum price for imported oil, or is there some other mechanism that Government could initiate that would take some of the volatility out of this price situation?

Dr. **Gibbons**. Mr. Chairman, the Strategic Petroleum Reserve is a way of buffering for our Nation and the world, and as Bill Martin has pointed out, if we could achieve that sort of process worldwide, we could buy cheap and sell high and make a market that would buffer these wild swings that occur for geopolitical reasons, so it seems to me there is an analogy on oil that is in flow, that if you could, in a sense, provide a signal, or provide a mechanism by which prices leveled out from these wild swings that go on, then you give the marketplace a lot better way to plan its investments. It simply cannot make long-term investments if it does not know what the long-term future is going to be.

Senator **Bingaman**. But you are saying, instead of stepping in and setting a minimum price for imported oil, you recommend that the Government become a more active participant in the market, in the sense that when the price goes up, the Government sells. When the price goes down, the Government buys? Is that what you are saying?

Dr. **Gibbons**. It seems to me that is a very similar mechanism of trying to provide the collective clout of the Nation to buffer these wild swings and enable, therefore, the marketplace to operate effectively and make long-term investments and move in the right direction, and you can do it either by storing oil, or you can do it by putting platforms on price.

Either gets you—it pushes you in the same direction, and I am not sure we can afford to ignore either one of them, and so I believe you not only need an SPR—it is already becoming evident, its value—but also that one should seriously consider this business of trying, somehow, to stabilize the price against those swings that are not market swings, they are geopolitical swings.

Senator **Bingaman**. Dr. Yergin, we had a hearing a couple of weeks ago where the administration set out its suggested ways to deal, or to improve energy efficiency and improve conservation. If we wanted to have a serious effort at increased conservation over the next several months in this country, what are some specific steps that you believe we ought to take, rather than pumping up our tires?

Dr. **Yergin**. Pumping up the tires will not hurt. I mean, we are going to have to look at motor transportation and there are really two ways to do it. You either do it through a gasoline tax, which is pretty unpopular in a lot of parts of the country, or you do it through CAFE standards, which is pretty unpopular in Detroit, but that has got to be—those are the two choices that exist in that area and that is the number one area.

I think that the picture that Dr. Gibbons put up about R&D expenditure is a really important one, that because of the changes in the 1980's in corporate America, you have seen a real shrinking of research and development. Its long-term thinking is penalized in companies that are turned into LBO's and so forth.

This role of research and development is a very important one for the Federal Government, and I think that—I am a firm believer that there are going to be technological responses and that we ought to have a diversified portfolio, and I think a really big emphasis on R&D, not in the synthetic fuels programs of the 1970's but across a diversified portfolio, is absolutely the right way to go for conservation and other energy sources.

Senator **Bingaman**. Thank you very much.

Senator McClure.

Senator **McClure**. Thank you, Mr. Chairman. Gentlemen, thank you.

I want to make a comment which I do not mean to be pejorative in any way at all, but perhaps it says something, and perhaps we should note it. Dr. Gibbons, you are the only member of this panel that has not been before this committee on numerous occasions before, and the others are familiar faces and familiar stories, and I just wish the public and the press had listened more to what you gentlemen have been saying for years and years and years, and maybe then Congress would have paid more attention, too—collectively, not just this committee.

Dr. Gibbons, thank you for coming up. OTA is a very important part of the equation, and I would like to think that your presence here today as director of OTA elevates the apparent interest of OTA. We have had witnesses from OTA many times in the past, but not the Director, and so I do appreciate your presence here.

I could not help but notice, Dr. Gibbons, you said something about the fact that we would rather commit suicide than learn mathematics, and Dr. Yergin, I want to point to page 2 of your statement, where I think we have found one of the proofs of that, because you mention on page 2 of your statement a 13-million-barrel savings because of conservation. I think you are off by a factor of not one, but two decimal points. I think it is 1.3 billion barrels.

Dr. YERGIN. That should have been 13 million barrels per day savings.

Senator McCLURE. Well, 13 million barrels per day would be against a 17-million-barrel import, but you are talking about total energy?

Dr. YERGIN. Total energy, yes.

Senator McCLURE. Thirteen million barrels a day comes out, as a matter of fact—I did a little quick mathematics, because I did not want to commit suicide. It came out to 1.3 billion barrels per year, and I think that is a significant amount that certainly we ought to take into consideration.

One comment with respect to the last round of comments about conservation. Conservation is like energy. There are a lot of different kinds, and a very, very different cost, and for us to say well, conservation is good, ignores the fact that maybe it is too costly.

There is a lot of conservation that is not too costly, and we ought to be doing; there is some conservation that is too costly, and we should not attempt, and somehow in all of this dialogue about what is a good alternative, we should be involved in. We ought to keep in mind that there are economic consequences to each of these choices, and cost is one of those economic consequences.

Dr. Yergin, you mentioned one thing in your statement that I think needs to be emphasized and is often forgotten, and you talked about the value of spare capacity. We do not have a shortage of oil in the world today. We are at the margins, and you call it a tautness in the market.

There is no reason for oil prices to have gone up except speculation and fear. There is no shortage of oil in the market today. There is plenty of oil in the market today, and I agree with you, Mr. Martin. I wish we could find some way to penalize speculators. I have not found that mechanism yet, along with the fact that some of those people are responding in fear. They are not speculating.

The head of the New York Commodities Exchange tells me that 90 percent of the commodity futures trading is from users. They are not speculators. They are just trying to make sure they have enough supply, which tells us, again, something that we ought to understand clearly, and that is in a modern industrial society, energy is absolutely essential, and people will pay almost anything for it, up to the limits of their financial capacity.

The emerging world sacrificed their nutritional gains in order to buy energy, very clearly that occurred in the 1970's and throughout the 1980's, but particularly after the 1979 price shocks when they had to make up their mind whether to buy food or to buy energy and they decided to buy energy because they had to have it in their own judgment, they had to have it.

Dr. Gibbons, a couple of comments with respect to your charts, and I want you to comment in response. One is with respect to the potential contribution of Alaska, far more than 500,000 barrels a day, and yet your chart and your comments said, well, it might add supplies by 500,000 barrels a day, but TAP line is the certain limitation on supplying the lower 48 today, and that is 2 million barrels a day, not 500,000 that you talked about.

Dr. GIBBONS. Senator, the 500,000 was from EIA projections of what you could get from the ANWR and not the North Slope. The North Slope is already in there.

Senator McCLURE. The North Slope is there and it is declining, and unless we build more pipelines, if ANWR comes on, it only fills the pipeline, and it fills it to capacity and keeps it full longer, but that potential 10 years from now is far more than 500,000 barrels a day, if indeed as you said we take the rosy side of projections up there. It may turn out to be nothing.

But if it is no more than that, they are not even going to drill. They might drill for exploration, but they are not going to drill for production if that is the limit of their expectation on ANWR.

A second point, you indicate in the charts that alternative fuels might be as much as 500,000 barrels a day. That damns alternative fuels by faint praise. The potential for alternative fuels is far more than 500,000 barrels a day in my opinion. Just 10 percent ethanol in gasoline will do that, and that is a very modest goal.

Would you care to comment?

Dr. GIBBONS. Yes, sir, I will respond briefly to that. I think there is more opportunity for alternative fuels in terms of quantity of supply, but when you look at the materials required, resource materials, the investment required in time to put these in place, I gave as an example, going up to 500,000 barrels a day of alternative fuels and 500,000 barrels a day additional from ANWR as examples of even—and that is a lot of effort if you look at the numbers required to put that in place over the next 10 to 15 years, enormous.

Senator McCLURE. Give us a price on ethanol and we will do that in 1 year.

Dr. GIBBONS. Well, sir, we have run the numbers of ethanol, you mean from coal or from corn for instance?

Senator McCLURE. I am not talking methanol, I am talking ethanol from biomass.

Dr. GIBBONS. Some of the new enzyme technology does make it look a lot more likely that we could take lignocellulose and make ethanol from it, much better than we used to.

Senator McCLURE. We have done that in Idaho. We were doing that 5 years ago.

Dr. GIBBONS. And you can certainly take sugar and turn it into ethanol from corn or potatoes or other things. Again, my whole example is to take a number—if you want to take 1 million barrels a day, I would be delighted to take 1 million barrels a day.

The point is the time required and the investment required to pull up that descending curve is enormous and we are just, I do not think we are serious about it yet.

Senator McCLURE. Well, you have not been serious enough yet and your point is exactly right. My point in questioning your charts is to indicate, if we are going to catch the imagination of the American public and the Congress, we should minimize the opportunities in those alternatives, and when you look at the alternatives, the opportunity is immense if we really get serious about it.

Dr. GIBBONS. I agree with you, Senator.

Senator MCCLURE. My time is up, I do want to make one comment about what Mr. Schuler said because I think it is important to remember, I almost was wrong, I was not quite, but almost. I said some years ago that there would be a political event in the Middle East that disrupted oil supplies at least every 10 years, and it has happened that way since back in the 1930's.

So that is not something that should surprise us. Now I missed by this much, one was in 1979 and the next one was in 1990. That was 11 years instead of 10, and so I will make this prediction now, very, very confidently, there will be another supply interruption before the year 2001 because of political events in the Middle East.

We do not know what it will be, we do not know who it will be, we do not even know precisely which country it will be, but it will be in the region and it will affect oil supplies and it will affect the world's economy.

Now we should just accept that as a fact and I appreciate very much the point that you stressed that, because far too many in this country have the belief that somehow they will sell oil regardless of what happens politically. How many times do we have to be convinced otherwise that there are political considerations to the availability of oil that are triggered by political events in the Middle East?

It has happened time and time and time again; it will happen again. And I just want people to write down now, I have stretched my horizon from 10 years to 11, because of the most recent experience—by the year 2001 there will be another.

Thank you very much.

Senator BINGAMAN. Thank you.

Senator Ford.

Senator FORD. I say to my good friend Jim McClure that it will be 5 years from the time that U.S. troops pull out when you will have the disruption. Of course, we may be there 45 years like we were in Western Europe, but nevertheless.

I have kind of gleaned two points from the testimony this morning, Mr. Martin and others, that we need a good working, international consumer market which is all inclusive.

What all four of you are saying, at least in my perception this morning, is that oil is not a free market product. It is not something out there; they use it. We have seen this before.

Let me ask you, Mr. Gibbons, you talked about SPRO. Mr. Martin talked about maybe a floor under energy prices, natural gas equivalent, barrel equivalent, or whatever it might be. Do you think we need both? I kind of worry about SPRO a little bit and the President has the authority to draw down and we draw 5 million barrels out and we use 18 million a day, that is just symbolic, nobody paid any attention to it and he had it done without saying anything about it.

So, there has to be some gauge or some triggering mechanism in my opinion if you are going to draw down SPRO, but I think the financial institutions probably would be more comfortable, if I could use that term, if they know—if you find a barrel of oil—what it is going to bring. Going to find natural gas, what it might do because the fluctuation, boom, and bust has created much of our problems in the Midwest.

Do you have any comment to that?

Dr. **Gibbons**. Two brief ones. Dan Yergin points out that SPRO works if oil-consuming nations all have SPRO's, but if we are the only one or if we and the Germans and the Japanese are the only ones, then it is our very substantial capital investment in the ground that is being shared amongst those that are not making those investments. I think we need a level playing field across the industrial nations, and I think Martin's testimony is right to the point on that one.

In terms of supporting the market, supporting at least a floor on the market, our mutual friend Harry Caudle once told me that when you have a really important situation and it is important that your pants do not fall down, you wear a belt and suspenders. It seems to me what we are talking about here is a need for belt and suspenders.

Senator **Ford**. I am glad to know that Harry's name was injected in this. He would have a little hard time with some of the things we are thinking about, talking about here today, but nevertheless——

Any one of the four of you can answer this, traditionally the Federal energy policy requires spending money. SPRO costs money. Eventually we may get it back by selling high, based on the lower price, but we do not have to invest in it, we will stay there. We can take it as an asset maybe.

Developing energy technology takes money. It also takes leadership. I heard my good friend say, he wished the world, TV and news and people had taken your advice years ago. I just wish the last administration had taken their advice and you agree with that, and we have agreed with that for a long time.

That incentives for energy efficiency cost money, yet in 1990, and we are struggling here today, one of the toughest questions I have is trying to worry about the Federal Government which has no money to spare. How can we devise an energy policy that does not depend on Federal money?

Mr. **Schuler**. Senator Ford, let me just respond to put that into perspective, because obviously it does cost money, but so does that deployment out in the Gulf cost money. We are spending ——

Senator **Ford**. Oh, Saudi Arabia is making $50 billion more a year. They pay us $28 billion, and they have got a little bit left over, and we become mercenaries. That is the way it is going.

Mr. **Schuler**. That is precisely the point. I think that there has been a monumental con job by the administration in suggesting that the Saudis and the United Arab Emirates are paying the bills for this deployment.

We are not paying the bill, perhaps, as taxpayers. We are paying it as motorists, because as you point out, it is a $50 billion back of an envelope calculation, and even at that, all we are recovering is the operating cost, the supplemental cost of having the troops there, rather than in this country.

The estimated costs—and these are difficult to estimate with precision, but there have been estimates that in the fiscal year 1989 defense budget, there was some $40 billion to $50 billion that was there in order to have the capability to project the forces into the Gulf, and that is not money that anybody is even pretending, con job or not, that we are recovering from the Saudis.

My point is that, as we review all of our energy options, there are costs and risks associated with each of them, and as Dan, I think, pointed out—or Jack—even with respect to conservation there are costs and risks associated with it, and I think we need to judge those costs and risks against the costs and risks of the alternative strategy of relying on Middle Eastern oil.

Senator FORD. Well, what I am trying to find out is, can we develop a policy without Federal money? I know the costs are out there, and the con job that is being done, as you so eloquently put it, and I understood it, but how do we get to it?

Dr. GIBBONS. Senator, may I respond just briefly to that same question? Obviously, you cannot get something for nothing, but it seems to me the role of the Federal Government is to make clear, on behalf of the Nation, that the nonmarket cost in energy systems show through so that consumers when they use it, and when they purchase things that use it, have a clear signal of what it is really costing them, both direct and indirect, and that is, it seems to me, a very legitimate role for the Federal Government to complement the market in that way.

How do you do that? Well, you could put on shadow prices, like regulations and standards, and we have done a fair amount of that now, and the system has changed—30 percent efficiency change in 15 years. Pretty good. It has been where most of the action has been.

It does take money to spend for research and development, but if you get it back in more cost-effective products you are ahead in the long term, even though you have had to make an investment.

But it seems to me the fundamental strategy is to try to help the Nation—the Government and the people—move along the least total cost path. That means you have got to identify where the costs are and make them visible so that the market can operate. That does not take a lot of money, but it takes a lot of guts.

Senator FORD. I think my time is up, Mr. Chairman. Thank you very much.

Senator BINGAMAN. Thank you.

Senator Burns.

Senator BURNS. Thank you, Mr. Chairman. I would like to associate myself with the words of the Honorable Senator from Idaho.

I have learned quite a bit this morning. And as the conversation goes along, I would pick up on the conversation of SPRO, and I have a couple of questions. But the use of the SPRO as I interpret it was that that was a security item that should this country need some sort of a buffer in national security, and some interruption to our supplies, offshore supplies, that we could operate for 90 days or so until we got our own production on line here, or some other alternative.

Then all at once it was injected into the conversation this morning that we are going to use the SPRO as a pricing tool. Am I wrong on that assumption—on my first assumption? Was that not for national security, rather than a pricing tool? Dr. Gibbons?

Dr. **Gibbons**. My memory is that it was put in place to buffer against sudden interruptions, as you say, as a national security tool. At the same time, if you have that supply there and can draw from it when you need to and then add to it when it makes sense, it serves a second purpose. But you are right, it began as a national security against interruption.

Dr. **Yergin**. But I think to add that the whole international energy emergency system that developed in the 1970's was aimed both at physical disruption, but also very mindful of the gross economic hardship, pain and difficulty that would result from really major increases in oil prices that the pain imposed on economic growth could really threaten, perhaps, the viability of institutions in various countries.

So at least my understanding of a reading of the record is that the SPRO was created for physical disruptions or massive price changes, because, after all, you can have a disruption at $20 a barrel, but that disruption will disappear at $50 a barrel and that is really what we are seeing now. The price will close the gap.

Senator **Burns**. Well, I would sort of relate to this, because we want energy security. We also want a food policy and food security in this country, and it seems that we have always gone down that path in our farm programs, and it has not worked there. Why would it work with oil and energy, especially now.

I am like Senator McClure. We chose to have energy at any price over food. I would say this: if we have only got a 90-day supply of food in the pipeline now, if we were to shut down trucking or transportation we would see a shortage on grocery shelves, I am wondering if that decision would not change.

Dr. **Yergin**. Well, I do not think the SPRO was ever intended to be a device for buffering the market in the sense that you have a cold snap and you suddenly use it, but it was aimed for a 1973 situation or a 1979 situation, and it looks like we are in a situation today, potentially, that is the same as that.

Senator **Burns**. Okay. Now, as you know, this town is driven by the budget talks and the so-called agreement, and this agreement was based on some economic assumptions which I would imagine most people have taken a look at. I would refer to that, because we tried to make some decisions on whether this is a good package or a bad package based upon the economy.

Would you agree, in 1992, that they are estimating domestic oil prices per barrel at $21.10 in 1992—and I see, Henry, you cannot hardly wait to get your hand in here.

Mr. **Schuler**. Ever since I read the article in The Washington Post, those price projections, I think they are certainly rosy in the extreme. The price that we enjoyed in the last couple of years certainly was maintained by an $18 a barrel ceiling that was imposed by Kuwait.

Now, there are various suggestions as to what Kuwait's motive was, but I think there is little doubt that it was a contrived price that was contrary to the wishes of all the rest of the members of OPEC, with the possible exception of the United Arab Emirates. Saddam Hussein thinks and says that it was designed to weaken the Iraqi economy and to undermine him. I happen to think personally, in my contrarian approach to things, that that is about right. Maybe the Kuwaitis had good cause, but I think that that is exactly what happened. In any event, it was a politically driven ceiling price.

We patted ourselves on the back saying, what a wonderful job we had done in reducing demand and prompting the fall of prices, overlooking the fact that there was a political motive for doing this.

Now, when this crisis ends, in my judgment—win, lose or draw—the need and the maintenance of that $18 a barrel ceiling is eliminated, and the prices will then go to what is probably a clearing price, the price—the maximum price at which the producers can sell oil without losing long-term market and I believe—and nobody knows until we test it—that that is a lot closer to $25 a barrel than it is to $18 a barrel or $21 a barrel, and so I think that the $18 a barrel ceiling imposed by the Kuwaitis has been turned into a $25-a-barrel floor.

Senator BURNS. Mr. Martin, would you like to respond to this? Do you agree with the assumptions that have been made in this process to the price of oil?

Mr. MARTIN. I think if the situation is resolved in the Middle East you could have a price collapse again. I would not bet on it, but if I were investing in the oil industry at this point I would have to remember what happened the last time. I put my money up, and the price went to $10.

We do know that previous to this event in the Middle East, many producers were going to expand capacity and that many of us at this table projected that it might be until the end of this decade until oil prices could go up, and there might be some question.

Right now, I would put it at about $25, though, for the sake of the budget argument, but I would be concerned that we have to do something to stabilize the price over the long term for investment.

Senator BURNS. My time is up, and I have some other questions for the rest of you. I wonder if you would be amenable if I wrote you. Some day I would like to visit with you. I found all the testimony very interesting this morning, and I want to thank you for coming. I appreciate that very much.

Senator BINGAMAN. Senator Wirth.

Senator WIRTH. Thank you, Mr. Chairman. I would associate myself with Senator Burns' comments. It has been a terrific morning as usual.

I would like to limit myself, if I might, to the gasoline transportation issue right now. I agree with you all completely on the need to move toward long-term alternatives in solar, to explore nuclear, to be looking at a balanced exploration production program, as you particularly so well pointed out, Mr. Schuler.

I would like to just focus if I might in the time that I have on transportation and transportation fuels. The fact, as you all have pointed out, is that about two-thirds of our oil goes to transportation, and I think, Dr. Gibbons, your slide showed that is about the number we are at. So if we are worried about our dependence on oil long term we ought to be looking at alternatives or looking at ways to conserve oil in the transportation sector.

That presumably should be our highest immediate priority. It seems to me the logic of that just stares at us. Your figures and your charts lead us right to that path.

If we are going to do that, then we have to do three things, I would think, and this comes out of your testimony: One, have more fuel-efficient vehicles; second, look at alternative fuels for those vehicles; and, third, have a realistic price structure. Those would appear to be the three highest priorities that we have.

If that is the case, let me ask you questions about each one of those. First of all, more fuel-efficient automobiles. Saddam Hussein has gone into Kuwait. We have 200,000 American troops in the Middle East, and we refuse to even bring up for consideration a discussion of fuel efficiency. It defies my understanding of what we are elected to do, but we refuse to do it. So we will come back next year.

Might it be a good idea when we come back to that, as we look at fuel efficiency, to do more than say let us just increase the CAFE standard, the average fuel efficiency. Maybe we could go to an alternative approach of rewarding gas-sipping automobiles. Let us make people who have gas guzzlers pay more. Instead of having across-the-board CAFE standards, set a standard and say people who are above that get rewarded in this marketplace, those who are below that pay more. If you want to have a Cadillac that gets 12 miles to the gallon, you pay for it. You pay an incentive.

Is that the kind of alternative to fuel economy standards in automobiles that seems to be a good idea? Does anybody have any thoughts on that?

Dr. GIBBONS. I could give just a brief response, Senator. There is a lot out there in terms of efficiency that one can roll in just with using elegant technology. We testified about this on the House side yesterday, and I would be happy to send you a copy of that testimony.

Senator WIRTH. I saw notes on that in your testimony.

Dr. GIBBONS. This supports the notion there is technology that we already know about, the so-called tech fix, but one can go beyond that. If we want to use in a sense our own sort of mutual coercion as a Nation to move toward a more efficient fleet, we can do it by pushing here and there the notion of an excise tax on the heaviest or the most inefficient automobiles. That is one that I believe is even in the budget package that I read about. It is certainly an idea, to push the market in addition to doing the best we can with technology.

Senator WIRTH. If I might just send you all some thoughts on guzzling versus sipping. It seems to me that we might use the marketplace to reach our goals; that if people want to pay more for a gas guzzler, they can do so. If they want to be rewarded for a gas sipper, they can do so. Let the market force do perhaps a more efficient job. It seems to me that is an alternative. It is kind of a CAFE, but it is an alternative for getting from here to there.

I have a limited amount of time. Let me jump to a couple of other thoughts as well. The second one relates to alternative fuels. You state, Dan Yergin, in your testimony that one direction is to increase the use of North American natural gas and to move away impediments to its use. You have testified very eloquently on that subject as well.

The President started us down the road to alternative use vehicles with the Clean Air Act proposal of the summer of 1989, where he said within a relatively short period of time we ought to have 1 million alternative fuel vehicles on the road. That was very noble and, I think, absolutely the right posture to be taking. Unfortunately, Detroit and the oil companies ganged up, and we are now seeing an erosion of that particular goal. Maybe Saddam Hussein will reinforce the backbone of the administration to come back to that originally very good proposal.

From the projections from the White House a year ago, we can back out about 15 percent of our oil use with alternative fuel vehicles, and that can be done within the next dĕcade. They thought 15 percent is about 2 million barrels of oil per day. Not bad at all to do if we were to move to natural gas.

Now there are impediments to this, as you point out, Dr. Gibbons, in your testimony today and earlier. Is there research now going on in the Department of Energy? Should we be supporting research on compression, the problems of how much compression, how much gas you can store in an automobile? You have compression problems, storage problems and so on. Is there now research in the Department of Energy or should there be for supporting alternative use, the technologies that will encourage alternative use vehicles?

Dr. GIBBONS. Senator, I would rather respond to that for the record because I am not intimately familiar with where the Department is at this point.

I do know that if we move strongly toward natural gas in automobiles, we are going to have to import it; if we are going to make a major amount of alcohol, for instance.

Senator WIRTH. It seems to me that, given the items that are out there, the alternatives and the impediments to its use which you talk about, Dan Yergin, we ought to be doing that research right now to see if we can bring on alternative fuel vehicles which then use the domestic fuels.

Dr. YERGIN. I think that is very sensible. I think one important thing to keep in mind is some need for clarity of signals. We have a refining industry that has gone through a decade probably of underinvestment. It is running at 95-percent capacity. We saw some accidents last year. We could have problems in the future. It is an industry that requires lots and lots of investment in the next few years to meet environmental goals in producing fuels. We need some clarity as to where the investments should be and whether the rules are going to keep changing.

Senator WIRTH. It seems to me that goes directly to Mr. Martin's final point as well, that we have to have some understanding of what the prices are going to be and where people are going to make long-term investments. We ought to learn from the 1970's, when we allowed the price to go up to almost $40 per barrel, and it came tumbling back down again. Now we are right back up, and we are going to absorb the price. The economy is going to absorb it.

Consumers are going to become more accustomed to paying a higher price, and it seems to me this presents us with a very good opportunity right now, as you are suggesting, Mr. Martin, to use that as a floor, to use this higher price as a kind of floor which would provide uncertainties for the exploration you are talking about, Mr. Schuler and Mr. Martin, and all of the alternative programs that the two of you were talking about. That would seem to be an absolute imperative.

Without it, we are going to continue to be the victim of wild swings elsewhere in the world and not master of our own fate, which a great power cannot afford not to be.

In any case, Mr. Chairman, thank you very much. Again, I appreciate your having this hearing.

To all of you, thank you very much for being here.

Senator BINGAMAN. Thank you very much.

Senator Domenici.

Senator DOMENICI. Thank you, Mr. Chairman, and thank you for calling this hearing. I am rather pleased that Senator Bradley is here because he is on the Finance Committee, which writes the tax laws.

Frankly, I believe most of the changes that are going to be made in the short term will impact on America's ability to produce more oil, and I want to focus on it, knowing full well that it is only part of the answer. Most of those are not going to be made by this committee. I think that is a frustration of this committee, but, clearly, they are going to be made in the tax writing committee.

I want to suggest that there can be all the talk we want about transportation being the source of eating up huge amounts of our crude oil use, but the answer is not that Americans are going to stop driving cars, because they are not. We cannot change America's social structure. Everybody believes being an American means owning a house and driving a car. Frankly, we built everything that way, so that is why we get all the furor whenever we talk about automobiles and seeking to use them less. It is a lifestyle that will take a long time, if ever, to change.

It seems to me, therefore, that most of the research ought to be directed at trying to get efficient automobiles or alternative engines that will drive that automobile for Americans. If I had a priority, I would say do that. If it costs more, let us put money in that.

Frankly, I will tell you that I have been here long enough to see a major program in that direction vetoed by President Ford, overruled on the Senate floor, and then the program to invest in alternative engines came down and down until it is almost nothing.

We ought to push the automobile companies with incentives to come up with some kind of alternative there as quickly as possible.

Now having said that, let me address the issue of assumptions in the budget. Frankly, there are those running around saying this understanding falls because of assumptions. Well, frankly, it does not fall. It just may not be exactly right in the second, third and fourth year, but the question that has to be asked is what do you do if it is not good enough. Those who say the assumptions are erroneous, therefore, do not vote for it, what do they want to vote for? Are they suggesting this is not a deficit reduction package of significant magnitude? It appears to me that it is.

Incidentally, I do not know if any of you have checked the long-term futures of oil recently, but they are very, very different from the short-term futures. I think that means something. I think that means that there is a war fear about that is in a strange way pushing the prices up in an inordinate manner. There is no reason for $38 oil other than people in the world are fearful we are going to have a war.

Having said that, let me tell my friend from New Jersey that I support the President using the Strategic Petroleum Reserve in a discreet way because of what I have just said. I believe he is right in doing that. Whether it will work or not, I do not know.

Having said that, Senator Bradley, when you start meeting on a budget package you are going to find and have an interesting opportunity to help. You have $4 billion set aside over the next 5 years for nothing more than incentives to increase America's production of oil and gas.

We have never had that before. It will be dropped in your lap with a skeleton notion of what should be done. Now let me suggest that there is one area that you ought to focus on and do whatever you can to sensitize to this marketplace of up and down prices.

And it is enhanced oil recovery, secondary and tertiary oil. Let me give you a number, Senator, the best estimates are that there are 76 billion barrels of American-owned, American-found oil sitting in the ground underneath oil wells that have already been drilled.

We take a third out, we leave two-thirds in the ground. The estimate is, in this great land that has produced more oil than any country in the world, that is startling to some but we have, under those wells sits secondary and tertiary oil that cannot be recovered at $18, $19, $14, $13 a barrel.

There is a very reasonable investment opportunity and an incentive opportunity that will get that out, and we have been talking about a floor. No one wants a floor, let me tell you. Discuss a floor in this budget summit and everybody from the Northeast assumes that means their heating oil is going to go up if you put a floor on it.

But there is another way, Senator, and let me suggest that you ought to look at it. Build the incentives in and say that they leave the scene, they are no longer operative if the price of oil is at a certain price. So that in the case of enhanced oil recovery, pick a price, I think it is $25 a barrel.

Give the incentives for its production, including the capital that is necessary to be invested, and you only need to recapture the capital. You do not have to give the investor any big bonus, just make sure he recovers his capital.

If the price of oil gets to $25, take the incentives away. You can also look at that approach to other incentives. You do not need a floor. What you say is, here is a new incentive for American producers, and if the price of oil comes below a certain amount it is off.

It seems to me that that is much more assurance than we have got today and certainly is not a floor, but rather a floor, in a sense, for the incentives that you might create.

I urge that you look at that along with others because it is the cheapest way to produce a lot of oil from American wells that are going to disappear. If we do not use them, they are disappearing within 5 years to 8 years, much of that oil will not be available under any circumstance.

Thank you very much.

Senator **Bingaman**. Thank you. Senator Bradley.

Senator **Bradley**. Thank you, Mr. Chairman. I want to thank the panel for their testimony and for their thoughtful view of this problem.

I would like to talk about the SPR if I could, and I would like to ask Dan Yergin, do you think, it seems to me like we are at least 5 million barrels from the stockpile which is really kind of peanuts when you think about it.

It seems to me that if we have a serious disruption, there are various ways to determine whether you have a disruption, and clearly one of the ways you determine the seriousness of the disruption is what happens to price, and price has gone from $18 to $40 a barrel.

Every day it costs the American public $320 million more a day to buy oil, and one of the criteria in the Energy Policy and Conservation Act for a severe energy supply interruption, one of the criteria was, may cause a major adverse impact on the national economy. That is one of the criteria for defining what a severe disruption is.

Now I do not know what a major adverse impact on the national economy would be if it is not people in this country having to pay $320 million more every day for the oil they consume. So do you not think 5 million barrels is too little, too late when we are really serious about using the reserve in the way that you have written about and the way that so many of us have urged that we do it?

Dr. **Yergin**. I know, Senator, that this is a subject that you have given a lot of thought to, and have provided a lot of leadership in how to think it through, including the issue of early release.

I think that first, getting the SPRO's to show that it does work physically, that is can work in market terms is very important because you do not want to do that when everybody is in a total panic.

Secondly, I am very concerned about what $40 price oil means for our national economy, not just what people experience when they go to the gasoline pump, that this is really going to reinforce the recession that already seems to be here and I think that there is a risk in this country and in other countries as to what those economic difficulties do to the broad international consensus that has been created.

And the next couple of months look to be the most potentially difficult months, thereafter, depending on how this resolves, and the passage of winter, we could see a lot of the pressure off. So I think there is a lot of reason for using the SPR more fully over the next few months and that we should be prepared to do that. It was created for this kind of purpose. This is a very serious crisis.

Mr. **Martin**. Senator, could I make one comment, that again collective action is important here. We should not do it without the draw of other nations——

Senator **Bradley**. But let us say, when we went to the IEA last week, should we have been urging a collective drawdown or are you pleased with what we have done?

Mr. MARTIN. I talked with the chairman of the IEA and Helga Steag as well and there is a disposition in the IEA not to draw stocks——

Senator BRADLEY. Yes, but what do you think our position should have been? Should we have gone there urging that we have a collective drawdown to reduce the pressure on this price that costs the American public $320 million a day? Should we have done that?

Mr. MARTIN. My view is that if what the IEA projection shows a 2 million-barrel-a-day shortfall, if that is a shortfall, yes, we should draw. But we also have to do——

Senator BRADLEY. So we should?

Mr. MARTIN. Demand restraint and avoid abnormal purchases on the spot market, which is again a past IEA formula. If indeed the disruption is going to come, I would think it would be appropriate.

Senator BRADLEY. So basically you do think we should have gone to make the argument that we should draw down the reserve?

Mr. MARTIN. I think the distinction is that, number 1, this is more disruption driven than price driven. We have debated this for 10 years in the IEA, and indeed in 1981, one of the reasons we avoided a price spike with the Iran/Iraq war was that we drew stocks and we avoided abnormal purchases.

So we know that stocks worked in that case. In 1979 we know the biggest problem was stock build. So I think that today's lesson though, and I go back, Domenici said something that is interesting though, we have the prospects of a war now and what is on the minds of the Germans and the Japanese is reluctance to draw the stocks because they think things may get worse and that stocks should be used as emergency reserves of last resort.

So it is really an interesting question. Do you hold your reserves as last resort or do you use them really as an economic tool? I think the trigger here should be disruption, and then we use it.

This is kind of the debate of the day.

Senator BINGAMAN. Mr. Schuler.

Mr. SCHULER. I would certainly agree with Bill's suggestion that the problem is, if you think that the situation is going to get worse in the Gulf and there is an outbreak of military hostilities, with all that that will mean for oil supplies from the region, and I think we can take as a given Kuwaiti oil, the wellheads and facilities have been wired with explosives and that they will be destroyed in a scorched-earth policy if there is a military attack on Iraqi forces in Kuwait.

I think we can, grading down from there, we can recognize that the United States has targeted Iraqi facilities and we can certainly deliver to those targets, probably not with the precision that we think we can.

And finally, there is certainly some possibility of terrorists or missiles getting through to Saudi facilities. So if you think that this crisis is going to, this confrontation is going to go on for a considerable period of time and that there is always that potential for an actual outbreak of hostilities, then I believe and I would recommend that we hold the oil for that actual physical shortage that goes on for a long time.

The other thing, if I may just add quickly, Senator, the other thing that I wonder about is I think we only get one psychological impact out of releasing the strategic petroleum reserve.

If the market price escalation is driven by psychology, as I think it is, and you now release it, you release some now, you get an impact out of it. But then the next time the price goes up again because of a real outbreak or something and then you release, I think the market responds with a ho-hum.

Dr. **Yergin**. Can I offer just one point, perhaps a different way of looking at the psychology——

Senator **Bradley**. If you disagree, speak.

Dr. **Yergin**. Yes, I disagree or at least I think you have to look at the other side of it. We just looked—take the 1979, 1981 oil price, put it in today's dollars and you are talking about oil prices over $60 a barrel.

If hostilities begin, you know what is going to happen, the price is going to go straight up and how long will it stay up? It depends on what happens. Is it better to have the SPR in operation prior to those unfortunate events happening rather than afterwards, because then the horse is already out of the barn, and over the last couple of weeks we have seen the horse get pretty close to the barn door as it is. So I think that would be the opposite side.

Senator **Bradley**. It is a very interesting point that you make, Mr. Schuler, because you are saying, hold that supply until the big one happens. Now how long is that going to be? 1 month, 2 months, 6 months, 1 year, a year and one-half, maybe never?

Now how long can the economy absorb $40-a-barrel oil before we are pushed into a serious economic downturn? At what point are you willing to say, well, my withholding the oil for the big one is the cause of the recession that we are now in?

And the recession that we are now in, for all that means for families that cannot pay for heating oil or all that means for joblessness and pain, whatever, it is okay, I still feel good because I have that oil in the stockpile for the big one.

Mr. **Schuler**. Senator, if you will cast your vote against use of military force in the Gulf, I will support early release of the SPRO.

Senator **Bradley**. You have to admit that you are facing a dilemma here, that on the one hand you want to keep the oil in case there is a disruption. On the other hand, you certainly, I assume, do not want to see the economy in a deep recession with a lot of people out of work and a lot of other people unable to pay for their oil.

So the creation of the reserve—I mean, when this happened in 1979, we had less than 100 million barrels in the stockpile. It is because of this committee that we now have 600 million barrels of oil in the stockpile, and the presumption was—and some of us have argued for a 1 billion barrel stockpile precisely because you have greater flexibility to use it in terms of economic threats, in terms of economic downtimes.

Mr. **Schuler**. But, Senator, if the price of oil is going to be forced to $60 a barrel or higher, we may look with longing back at $40 a barrel oil that we find unacceptable now. That is the problem. If you can rule out the military, the use of—if you can rule out military hostilities, it all makes sense.

Senator **Bradley**. So you continue to assert that you want to keep it for the big one, no matter whether we are in a deep recession with bank failures and everybody else in trouble? We have still got that oil in the stockpile. I mean, we have got a budget deficit, too. Did you ever think of that? If we sold 10 million barrels of oil a day, we would have $400 million.

There are a lot of people who advocate all kinds of assets sales in the last couple of years to deal with the budget. Well, here is an asset that you could actually sell that might help the economy and reduce the deficit. It is something to think about, is it not, Mr. Schuler?

Mr. **Schuler**. I think it is like selling your insurance policy. You could always turn it into cash, but then you have given up the insurance that some people think is worth having.

Senator **Bradley**. Well, you know, I think people are going to slowly recognize that it is like, you know, death by a severe accident or death by a slow illness. I mean, which is worse?

If you get into an economic downturn, if you get into people who are out of work, if you get into worry about a budget deficit, if you get a point up on the unemployment rate, you add $20 billion, $22 billion to the budget deficit, and if you could avert that—I am not saying sell 600 million barrels, but at least sell enough so that you are able to test the hypothesis, which 5 million barrels clearly does not.

I mean, 5 million barrels is an attempt to see if the system works well, which is okay, fine, and good. I would like to see the system work well. But I mean, even with your premise, which is do not use it until we have a supply disruption that is severe, why should we not do 15 million barrels a day to test it? Why should we not do that?

The House passed a bill 2 weeks ago. The Secretary of Energy was there saying well, you cannot do it, because the law says we can only do 5 million. I said well, how much do you want to do, Mr. Secretary? He said well, we would like to do 15 million.

The House passed a bill. Do you not think the Senate should pass a bill to allow them to test whether when the big one comes he could get oil out of the stockpile into the market? Would you not advise that we go with 15 million barrels a day as a test?

Mr. **Schuler**. I guess I would suggest you might find just as much disappointment with 15 million barrels a day and the impact on the market.

Senator **Bradley**. No, we have moved away from the economic argument now to accept your premise, which is, we only want it for the big disruption. But if we only want it for the big disruption, then we clearly have to be able to get it out of stockpile, and we really need a bigger test.

Mr. **Schuler**. Okay. If a bigger test is required to prove that it works, right on.

Senator **Bradley**. Do you think we ought to go ahead and pass the bill that the House passed, 15-million-barrels-a-day test, which is what the Secretary of Energy said he wanted the other day in the House?

Mr. **Schuler**. And make it clear that you are not expecting it to dampen price escalation?

Senator **Bradley**. I do not think anybody is expecting 5 million barrels a day is going to have a big impact on price, particularly when it comes—what?—6 weeks to a month, or 2 months into the crisis. I mean, if I have read Dr. Yergin at all, I mean, when you want to use this, you want to use it immediately, or you want to use this when all of the inventories in the private sector are trying to say well, you know, are we going to be able to get oil if we draw down our stocks?

Dr. **Gibbons**. Senator, I would suggest if we try for 15 million barrels a day, we might be inviting failure, because that is a pump rate that it seems to me does not match to what we are bringing in from the Mideast. If the whole Mideast shuts down, it is 2 million barrels a day.

Senator **Bradley**. I am sorry, if I said 15 million barrels a day—it is a 15-million-barrel test.

Dr. **Gibbons**. It seems to me a very interesting test of great psychological relief, including me, would be to show that you can pump 1 to 2 million barrels a day, and actually get it out of the ground at that rate, which corresponds to a half, or all of the Mideast shutdown. That also might give a signal to those that would tend to want to speculate on price these days.

Dr. **Yergin**. Because, you know, you found in the marketplace in the industry that there has been lots and lots of skepticism about the SPR. Will it work? What are the criteria for using it? So it really has tended to be discounted, and 5 million barrels a day, as you say—or a 5-million-barrel test—establishes some of the physical questions, but it does not really address that question on any scale.

Senator **Bingaman**. Could I ask that we continue on the next round here? Senator Murkowski has been waiting quite a while.

Senator **Bradley**. If I could just make one final point: if we had 15 million barrels drawdown, 500,000 barrels a day over a month, that would give you a good test, and as you say, Dr. Gibbons, it might actually have some impact on prices.

Senator **Bingaman**. Senator Murkowski.

Senator **Murkowski**. Thank you, Mr. Chairman.

You know, I am somewhat confused at the constant reference to those that suggest that there is no shortage, but if you look at reality, you note that the Iraqis are no longer putting 3 million barrels a day on the market, and the Kuwaitis are not putting 1.3, so that is being replaced by increased production from other areas.

But to suggest that there is not a shortage I think is unrealistic in evaluating the factual situation, as far as the availability of oil on the world market, and any time you have a reduction or a drawback, why, you have those that want to pull inventories down because of their concern over the unknown, and so the supply availability is thwarted and the price goes up. There is no magic to that.

You talk about SPRO. The reality of SPRO is, we are doing a test. It was mandated by Congress. The significance of that is meritorious in one sense, but it is—what?—5 million barrels over 30 days? That is a test. That ought to be a pretty easy test. If it is going to work at all, they ought to be able to pull 5 million barrels in 30 days.

My information is the maximum production capacity of SPRO is about 3.5 million per day. That is what the system can pull out. So clearly it is not designed to replace a significant amount of our—what?—7 million to 8 million barrels that we import every day. It is to supplement and, if we want to change the whole physical characteristic of SPRO, increase the production capability.

But the difficulty is—and I am sure my senior colleague from Idaho would agree—we have no clear cut, definite policy as to how we go about addressing our strategic reserves, whether it be mineral reserves or what have you. We buy up certain things, put them away, and then nobody really understands the formula or the application that is necessary, what has to be triggered to do it.

The same thing with oil. Clearly, I do not consider SPRO an answer, as it is currently postured, because of the physical characteristics of its inability to move enough oil out in any given period of time.

Another area that I am a little disappointed that your evaluation did not consider, and that is perhaps because I am more sensitive to it, is the realization that we are expending somewhere in the area of $70 billion to $90 billion a year bringing in oil into this country. That is a pretty heavy foreign ticket to write. It adds to our foreign debt.

What would half that amount being expended into the domestic energy alternatives—the broad-breadth coal/gas alternative—what would that do to the economy of the United States and jobs, added tax base? I listened to the gentleman—I think, Mr. Schuler—who advocated the potential from Venezuela, and I do not dismiss that, but by the same token, that is U.S. dollars going out.

There, in OPEC, we are obviously being held, and have been held, hostage by OPEC, so we have another opportunity. I wonder why we do not focus into the realities of trying to reduce our dependence, as the President suggested in his statement, on imported oil, and at the same time look to what we can do to spur our own economy and the resource development?

I recognize as well as you do that we run afoul of the Corps of Engineers, and we run afoul of the Environmental Protection Agency, who have regulations and laws that absolutely preclude you from getting there, but it is time the American people understood that there are domestic alternatives that will provide U.S. jobs, a U.S. tax base, and relieve us a lot of our budget constraints. We look to you folks as the experts in this area, and I am frankly disappointed that you have not given that aspect the attention that it deserves.

Mr. SCHULER. Senator Murkowski, if I could address this. I am not an economist, but if these alternatives are economically viable, then the economy and the competitiveness of the United States and the world trading system does not work.

Senator MURKOWSKI. Who says they are not economically viable?

Mr. SCHULER. I think the market has told us they are not economically viable or they would be on production. A particular problem is transportation fuel, and that is why I look to liquid hydrocarbons for that.

As has been pointed out, we use 10 million barrels per day of transportation fuel, not only gasoline for automobiles but diesel for locomotive and trucks and jet fuel and fuel for boats, 10 million barrels per day. Last year we produced a grand total of nonoil-base transportation fuels of 30 million barrels. That included all the ethanol, all the shale oil, all the compressed natural gas, and all of the electrified subway systems. It says that we run our transportation system on oil-based products for 362 days of the year and we use up all the rest on the last 3 days of the year.

Now why is that the case? It is because with all of its problems, oil-base transportation fuels are the most economically viable, they are the most efficient. The handling and transportation is the most advantageous, and in many respects they are more environmentally acceptable than others. So this is the basic problem.

It is not that anybody is dictating the use of oil. It is that the attraction of oil is so great that other things cannot compete.

Senator Murkowski. That is a given, and that was evidenced by the reality that we became 45 percent dependent on imported oil because the oil was cheap. Your application on economics is correct.

By the same token, you have the logic of a mix here. You also have an economic concern about down turns in your economy. You have a concern about increasing foreign debt. So you do a little shift, and you say, hey, as a policy we are going to do things that will spur our own domestic resource industry. Some of these things are in that budget. There are incentives. That is a plus. That adds jobs in the U.S., adds tax base, reduces our dependence on foreign-imported oil.

Foreign-imported oil under the premise that you are using was cheap. Today it is not cheap. Tomorrow we do not know.

The last part of my question concerns where we are going to be in 1994 and 1995. Dr. Schlesinger sat before this committee, and he said, in effect, come 1995 the production capabilities in the Mideast—and this was before the Iraqi conflict—will be totally committed, the production facilities. Not that they are out of oil but the ability to produce more oil beyond those facilities will have been committed. The realization that you have the unification of Germany, the Baltic States, more oil is going to be in demand.

Is that not a forecast for increased price as the demand increases and the production facilities, everything else being a given, basically come to the point where they are committed? Now you can expand that. The Soviet Union is not producing more oil. They are producing less. They were producing 12 million barrels, and now they are producing 11.

These are facts, and where is the forecast for a situation other than—I think Jim is perhaps a few years off. I think you are going to see this before the year 2000.

Mr. Martin. Senator, we have talked about this for the last 10 years, that this day would come. We knew it would come. It is no surprise. This committee and the administration put forward some useful things like developing ANWR or tax incentives for the industry or plain coal technology or streamlining nuclear licensing. We had the options before us; we agreed upon them, but there was no public sentiment for them because the public liked the cheap energy and was not really willing to pay a price for security. It really comes down to that.

We now have a huge externality which is almost to the point of a war which again recognizes that the economist who relies on cheap oil in the 1980's has to be paid in the 1990's because we did not take action.

I hope this committee, particularly this articulate committee, and experts alike say now is the time for action. We need an energy package, and we need it now.

Senator MURKOWSKI. Let me interrupt you now. The difficulty with an energy package is people up here do not want to make the hard decisions of what you are going to put in it. I have National Energy Security Act legislation that is over in conference now, and they are afraid we are going to open up wilderness areas. They are afraid this is a charade for opening up ANWR. They do not want to make any decisions because they all have self-interest groups.

That is why we have no energy policy in this country. The Congress cannot sit down and say this is what we are going to do, we are going to increase nuclear by 10 percent, we are going to go off in some of the public areas and open it up. We are not doing it.

Until the public wakes up and says, hey, we either get some relief or we are going to throw the bums out, why, you are going to have more of the same. It is absolutely ludicrous the way this situation is set up around here. We have the responsibility as the Energy Committee, and the Senator from Idaho has spent years and years. The reality is that we have to make decisions, but we do not make decisions.

So I would hope as you gentlemen look at our alternatives you remember that charity begins at home. I happen to come from Alaska. You talk about CAFE standards. They are important, but, remember, in 1974 we came on with the first CAFE standards, and we picked up about 1.5 million to 1.8 million on that savings alone. Within a year, we came on with the Prudhoe Bay pipeline that dumped 2 million barrels on. Do you think that was used? You bet it was.

So for the last 17 years through a 4-foot pipeline we have been receiving 24 percent of the domestic oil produced in this country. That almost did not happen because Spiro Agnew had to break the tie. The moose would not cross it. There were just crazy things that we are seeing today.

We are seeing the same thing on ANWR. They say, hey, ANWR, it is a 200-day supply. Hell, if it was a 200-day supply it would be the third largest oil field ever found in the United States. They say Prudhoe Bay is a 600-day supply. It has been there for 17 years. What else is it going to do?

The necessity of enunciating this is to see the terrible inconsistencies that exist at our level, and we have to depend on you people for some hard-nosed recommendations. We are going to need all of the above. We are going to need CAFE standards. We are going to need energy efficiency. We are going to need gas. We are going to need coal. We are going to need to go out in our frontier public areas, not in wilderness, not in national parks, and get off the dependence of the Mideast or we are going to be right back here.

Thank you for the extra time, Mr. Chairman.

Senator BINGAMAN. Thank you.

Let me ask a little bit more generic a question.

Dr. Yergin, you have been following the subject here for some time. I know all of you have. Let me ask your view as to what the Congress and the administration could do now to help insure continued attention to this problem once the Iraq situation is resolved?

We do not have goals in the area of energy. We do not have goals, really, in any area, although the President and the governors have come up with some that they claim are national goals in education.

Would it help to institutionalize some annual goals and then have a report on how we are doing with respect to those, or what could be done now that would actually keep us focused on this as we go through the 1990's?

Dr. YERGIN. That is a very good question, because when energy is at the top of the agenda everybody is mad at everybody else, and you get a lot of heat and friction. Then when energy is not at the top of the agenda, as we have seen, people really forget about it, and it goes back to this empty room last March when this committee was addressing these very same questions and the reality was there on the table.

Perhaps some kind of goals or targets that—I mean, it is so interesting. The numbers are there, the realities are there, but they do not get seen. If you take it on a daily basis, the U.S. has lost actually more than 1.5 million barrels per day since 1986, a number that is virtually invisible.

If there is some way, as you are suggesting, to bring forward the key indicators—I know Bill Martin tried to do that in the energy security project—and to do that on a cooperative basis with the Congress and the administration, perhaps there could be that sustained attention. Maybe now that this has happened a third time people will not wave their hand and say, oh, it is never going to happen again and everything is fine from here on, it was just because of this or that problem in Washington that this happened, that we can watch these key indicators.

One hopes there has been some learning, that we have learned some things not to do in response to this kind of situation, although some of the script over the last 2 months has sounded very familiar, I am sorry to say.

Senator BINGAMAN. Dr. Gibbons?

Dr. GIBBONS. I would offer three interesting goals. One would be to increase our efficiency of use by about 2 percent per year. We have done it for the last 15 on the average. There is every bit a sign that we could continue such a pace toward using technology to enable us to use energy more efficiency.

The second one, think about some limits on imports in terms of the diversity and the quantity. I showed you figures this morning which indicate that a 50-percent import rate is going to be tough to beat. You might want to consider the diversity of imports and the quantity and put some limits on it as a national goal.

Thirdly, some rate of advancement toward this non-fossil energy system that we have to move to for our grandchildren. I do not know what the number is. Maybe it is 1 percent per year for a while, but some kind of number that is a benchmark we can measure year by year, decade by decade, about how we are doing. It might make an interesting national goal.

Senator **Bingaman**. Dr. Yergin.

Dr. **Yergin**. There is one interesting question I do not have the answer to, but it is worth pondering for all of us. The U.S. has become about 30 percent more energy efficient, and thank you for catching my arithmetic error. In the same time, the Japanese, working from a much narrower base, have become about 55 percent more energy efficient. It would be very interesting to understand what they did and how they have done it.

Senator **Bingaman**. Let me also ask, I know we have talked about how we have to get the Japanese and the Germans and everybody to participate in order to stabilize the price of oil. The little information I have been able to obtain indicates that the price of oil has not resulted in the dramatic increases in the price of gasoline in Japan that it has resulted in here in this country, and that in fact the consumers in Japan to date have not felt the kind of price shock that our consumers have felt here. Is that accurate, and if so, how do you explain it?

Mr. **Martin**. It is because they have a major tax on gasoline.

Dr. **Gibbons**. They are already paying $3 a gallon.

Mr. **Martin**. The increment between what they are paying before and after is very small, compared to ours, where we have such a minimal price for gasoline.

Senator **McClure**. Would you yield on that, because the Energy Information Agency indicates that the price of gasoline in Japan has gone up 29 percent since the end of July. Ours has gone up 24 percent, so that as a matter of fact, the gasoline price before taxes has gone up more in Japan than it has in the United States.

Dr. **Yergin**. You see, it varies from country to country. Some countries, of course, their currency has appreciated and—the Germans, for instance—and so they are seeing—and oil is priced in dollars. Not necessarily Japan, but other countries. In Italy, you know, it is almost $4 a gallon, and almost all of that is tax to begin with.

But the Japanese, where the Japanese have seen it is in their financial markets, where you have seen their stock market fall by roughly 50 percent, and you know, there is a suspicion—people tend to see things in simple terms, and there is a view in Japan as elsewhere that there is all a reason for this. It has to do, going back to some of the same kind of suspicions that existed in 1973.

But there is no question that the Japanese are having an oil shock right now, and it is felt in their financial markets, so we are going to feel that reverberation in our financial markets.

Senator **Bingaman**. Let me just ask a final question, and then I will defer to Senator McClure here, but the suggestion that we use the Strategic Petroleum Reserve to eliminate some of the volatility in the world price of oil, that suggestion has been run through the questions all morning here, and I guess my question is, if it makes sense to use the Strategic Petroleum Reserve to moderate price increases, does it not also make sense to use the Strategic Petroleum Reserve to moderate price decreases?

Dr. **Gibbons**. If you are smart enough about it, you buy low and sell high, and in time—of course, we probably will do the opposite. When prices are very soft, that is the time to fill the reserve, and when they are very hard, it is time to spin back out. It is sort of a Keynesian philosophy applied to oil.

Senator BINGAMAN. Well, we have never had that as a policy of our Government, that we would try to moderate price decreases by use of the Strategic Petroleum Reserve. That would be anathema to the free market mentality which has driven our national energy policy for the last 10 years, at least as I have understood it.

Dr. GIBBONS. But Senator, if it were invoked in response to geopolitical things which are nonmarket activities, in my book it seems to me that is a better way of saying it than we are simply going to use it to try to level out price or overwhelm the market. It is to complement the market when the market is being overwhelmed by events outside the traditional free market.

Senator BINGAMAN. Senator McClure.

Senator MCCLURE. Thank you, Mr. Chairman. Thank you, gentlemen, for your testimony. It has been instructive, and I would just wish we could get this consistently before the American public every day of every year until we do take those combinations of actions that Congress ought to take to result in an energy policy that is much more affirmative than the one we have now.

Mr. Martin, I appreciate your suggestion a moment ago that yes, indeed, there have been attempts in the past—attempts by the past administration as well—to put elements of energy policy in place and the Congress of the United States has rejected those efforts. I think that is not just a partisan political statement. It is also a political statement in the sense of the mood of the country.

There are those who do remember past disruptions. There are those who do know that there are certain actions we could take that would make a difference, and some have suggested them, and they have not been adopted. I am a little bit tempted—more than a little tempted—to point out that, indeed, some who are complaining about the high price of oil have contributed to that high price of oil by inhibiting supply.

That is, voices within this Congress, and some on this committee, who are now complaining about—terribly concerned about—the effects upon the people of this country in terms of price, or in terms of economy and unemployment and all the rest of the economic effects of this price, but the actions taken in this committee and in this Congress have helped create the scenario in which that is exactly the reality.

But that is not just their fault. That reflects the mood of the American public. We want it both ways. We want it all ways. We want cheap and easy fixes. We do not want to pay any price for any solution.

We have an environmental problem? Well, certainly, we will pass a Clean Air Act. What is the Clean Air Act going to do to energy self-sufficiency in this country, or competitiveness in the world, Mr. Schuler? We cripple ourselves in a whole variety of different ways in terms of energy policy, because we have conflicting demands on policy, and we oftentimes ignore the energy policy side as we seek to find a solution to the other policy questions we have.

Environment is a real concern, but we cannot even drill in the Santa Barbara area, where we know the oil is there. It is there in such quantity that it seeps out. We would help the oil seeps if we would just drill and produce some oil, and might protect the environment of the Santa Barbara coast if we would stop those oil seeps. The way to do that is to get some salt water down in those formations instead of oil that is coming out.

We cripple ourselves in a whole variety of different ways in terms of energy policy. I know Senator Bingaman has great concern about the WIPP project. It is not a domestic energy policy, but it is a nuclear policy for this country, and we are trying at the same time to deal with nuclear waste.

We are totally paralyzed in this country with respect to Yucca Mountain. We cannot move forward. The Secretary of Energy has tried. That is energy policy. But we are totally, completely stopped in developing that energy policy, because of other concerns and other considerations.

I told Senator Murkowski I was sorry he was leaving, because I was going to disagree with him in part—a very small part—and he understands. There is no current oil shortage. Now he said we should not say that, but it is a fact. World oil production capacity today closely matches world oil consumption, and I am talking about with Iraq and Kuwait out.

Now, you are right, Dr. Yergin. It is a very tight supply system, and it does not work well when it is tight, and people get nervous when the supplies are tight. They begin to worry about whether they will have theirs. I sat with the president of Delta Airlines a few nights ago, and he said the current price increase in jet fuel is going to cost Delta Airlines $160 million a year.

He is one of those that is out there buying on the futures market, buying product, and he is one of those bidding the price up, because even though it costs him $160 million a year, what would it cost him if they did not have enough to fly?

So they are going to pay the price to make sure that they have a supply of jet fuel in the future, no matter what the price is, within limits, and they are going to drive the price up, because that is exactly what they have in mind, in a very, very tight market.

So while there is no current supply, people are worried about whether there will be a current supply shortage 2 months from now, and that points up another reality, and that is the loss of refining capacity in Kuwait and Iraq was probably more important to the world in the short run than was the supply of crude, because the real shortage that we are going to have this winter is of home heating oil, and I do not mean to exacerbate the fears in that market, because finished product capacity is less than future finished product demand during this winter.

No wonder people are worried about home heating oil, and I notice that this budget package, while it has a tax on everybody else, does not have any tax on home heating oil. It just happens to be that the Majority Leader is from New England. I suspect that might have something to do with the shape of that budget package. That is how we get distorted in our congressional actions, if all we focus on is energy.

I do want to at least point out a couple of things with respect to current speculative forces in the market. The Energy Information Agency indicates that prices in Belgium have gone up 41.5 percent since July 30. In France, they have gone bad for United States. I up 56 percent. In Germany, they have gone up 42 percent; in Italy, 41.5 percent; in the Netherlands, 35.5 percent; in the U.K., 37.7 percent; in Japan, 29 percent; and in the United States, 24 percent.

So prices have moved up less here on the retail market for finished product. This is retail motor gasoline prices, excluding taxes and duty. They have gone up less here than they have in the other countries, which also says—and I think it is rather instructive to look at this—the more dependent you are on imports, the more price volatility there has been, with the exception of the U.K., and with, perhaps, the exception of Japan.

So the Continent has gone up very rapidly, and those are transportation fuels, too. It is not just their industrial load or their home heating loads that have gone up. This, we are talking about motor gasoline prices. Speculative forces are controlling the market today. The psychology is more important than the supply. And that gets us back to two suggestions that were made, and I think they are worthy of exploring.

I do not believe in using SPRO for strictly economic, short-term economic swings. Every time the Government has tried to control prices has been a disaster. Every time we tried to use stockpiles for economic purposes, we have really hurt basic production capacity in this country. Our question is, in this regard, at what margin of price change does it become more than just a temporary market swing?

Can anybody tell me what Saddam Hussein is going to do? Can you, Mr. Schuler, indicate that the United States is going to abandon international political goals and allow him, Saddam Hussein, to remain in possession of Kuwait?

Mr. SCHULER. I think that the only, nobody can predict what is going to happen, and if there is—but we can predict that if there is military hostilities, the situation is going to get a lot worse before it gets better.

Senator MCCLURE. That is in terms of energy supplies. And some will suggest that unless there is military action, the situation will get worse in other respects. And that is one thing that I want to point out is, while it surely, the deployment of U.S. forces in the Gulf costs us a lot, it costs us a lot less than another $10 increase in the price of oil.

Mr. SCHULER. It may have both.

Senator MCCLURE. We may have the best of both worlds, you are telling me?

[Laughter.]

Senator MCCLURE. We will have hostilities, and death, and high prices, and economic recession all at once. Well, that is one possible scenario. But I think that the evidence was abundant that if we had not done anything, Saddam would possess the Gulf oil production capacity today. He has sent a lot more troops into Kuwait than was necessary to pacify Kuwait.

He is a reckless man, power-hungry, megalomaniac. He is a man who is, has the capacity to make massive misjudgments about the consequences of his actions, and there are, you will read a lot in the last few weeks about the United States should have known he was up to something, sending all those troops down to the border of Kuwait, but nobody seemed to be saying, United States should have known something about him sending all those troops into Kuwait about what he is going to do next.

So I think there is a reason for us, in terms of security and the economic impact upon this country, to have our presence in the Gulf today. I hope it is brief. I would like to see Saddam leave the scene one way or the other, back out of Kuwait, whatever it may be, have an internal coup inside of Iraq, which many people are suggesting may happen, and I talked to some people who have been in contact with some of the refugees who are talking about political unrest inside Iraq.

I hope it is true. I hope the embargo works. I hope it works short of having to go to war. There could be very real consequences, however, to us removing our troops without having attained any of our objectives in terms of both current and future policy in this area.

So I do not know what the answer is, and I cannot make a prediction about whether or not this is a short-run price effect. Mr. Schuler, I share your concern that we do not dissipate SPRO on the basis of a marginal action that may last a long while. We could withdraw 5 million barrels a day, or 3 million barrels a day, or whatever it was we decided, and dissipate that reserve over a long period of time, and when the real crunch came, we would not have 90 days' supply, we would have 45 days' supply, or 50 days' supply.

And I am a little bit concerned about the suggestion that was made by someone that we should diversify our sources of importation, because oil is a fungible commodity. It does not matter where we get it from, or where somebody else gets it from. It is a worldwide market and it will flow to wherever the demand is, and wherever the price is. So it does not matter much whether we get it from that source or if somebody else does, as long as we have any kind of a joint international action.

It will not be as 1973 was, with only an embargo against the United States and the Netherlands. Under the current situation, if the supply for the Persian Gulf is lost, everybody loses. And you may well have the Dutch being the major importer of Venezuelan oil.

We, at the same time, have done nothing in this country to encourage the construction or the maintenance of existing refining capacity. And we can pump the oil out of that ground down there a lot faster than we can process it through our refineries, I suspect; I do not know that.

And any test that was really meaningful has to test that, too. Can we pump it into pipelines that go to refineries that can handle it? Or will we pump it into pipelines that go to refineries that cannot handle it?

We were very fortunate, indeed, that some other countries have invested in refining capacity in this country. I am grateful the Venezuelans did. I am grateful that the Saudis did. Because it does do something for stability of supply and stability of an energy relationship between our country and theirs when they have the stake in the refining capacity in this country as well as the market in this country.

But there are some people who raised their eyebrows when foreign investors bought up domestic refining capacity: Gee, that is think quite the contrary, it is good for the United States in the long run.

But when will we begin to look at decisions like wilderness designation on the public lands of the West, on decisions like ANWR, like decisions about restrictive management and utilization of these resources in this country in terms of their impact upon energy supply, dependence, and economic vulnerability?

Because we are debating here not about military security; nobody is threatening to invade the United States as far as I know. But our economy has been invaded in the marketplace, and we are at the margin of being hurt badly. And I think maybe that is what the debate is about in using SPRO—what is that margin, when should we respond?

Should we try to have any kind of a mechanism that triggers our use of SPRO for economic response? And if so, at what level? And if any of you wish to submit any comments with respect to how we might structure that policy, I would invite you to do so.

A second suggestion that was made, and, Mr. Martin, you made with respect to international supplies of reserves, I think we must increase our pressure on our allies and trading friends in the world to build reserves.

I am afraid the IEA has allowed ourselves to be misled a little bit in the recent past, as stocks in many of these countries increased. They did not increase because they wanted to increase reserves. They increased their reserves because the price was low. Now they are taking credit for that great foresight in terms of security arrangements, and really what they were doing was prudent market economics.

Yes, we need to have an energy policy that will focus on those matters. Is a floor price a good idea? I think it is. I have long thought that it is, so that we can induce people to make investments, knowing that the investment value will not be destroyed by Middle Eastern oil producers, and they have the capacity to do that. They have done that twice in the last 5 years.

You know, we can talk in a vacuum about them making investments, but if it was my money, I would be looking at what they could do, and I suspect each one of you would, too. I know that the oil shale development, one of the few successes of the Synfuels Corporation, is marginal at $50 a barrel. Probably losing money at $50 a barrel.

How do we get people to make investments, in technologies or in production or in production capacity, if they do not have any idea what the energy market is going to be? It is totally, totally subject to the whims of oil producers that act for whatever reason.

Mr. Schuler, I am not certain I agree. I am not certain I disagree that Kuwait was trying to hurt Iraq by driving prices down. They may have been; terribly foolish policy, as I think they may have found out already, if indeed that was true.

Mr. SCHULER. High risk in the extreme.

Senator MCCLURE. Well, yeah, if you are a little guy, you do not really jab pins into the big guy right next to you who may be asleep. And if that was their policy, they are, maybe they are getting their just desserts.

But we are affected by it, the efficiency gains. I do not think we can get them as easily as we got the last ones. I do not think that the United States Government policy really affected the efficiency gains nearly as much as the market did. When it makes economic sense to invest in efficiency gains, the market seems to do that pretty well. And we got a lot of efficiency gains, as has been pointed out, but we will not get another large run of 25 or 30 percent efficiency gains at reasonable prices in oil—reasonable, from our sense. We want it cheap, do we not? We do not want to pay any price. And if we do not have higher prices of oil that again run up higher than they were before, we are not going to see the same kind of efficiency gains that we saw over the last 10 years.

And Government cannot force-feed that; Government can induce some marginal gains. How much are we willing to pay? Well, I hope one of the things we would be willing to do is to look at either the suggestions Senator Domenici made about incentives that are triggered in and out according to price of oil, or that we get a floor price for oil, so that we get some stability in the energy markets that will induce some investment.

It is a tragedy stripper wells closed down. And we are not going to get them opened again at $20-a-barrel oil. We know that. The 1986 tax act that the Congress of the United States in its infinite wisdom passed exacerbates our energy problem today in a variety of different ways. The administration did not do that. Congress did that. And Congress will make some other mistakes.

But somewhere, somehow, we have to get through to the American public that guys like Jim McClure saying a few years ago you are going to see American boys shed blood on desert sands in the Middle East because of lack of energy policy, was not just whistling in the dark.

That will happen again. It may not happen for another 10 years, I do not know. But it will happen again unless, unless we get better energy policy than we have had, and unless the American public is willing to pay the price for its policy options. You do not buy environmental gains on the cheap. You have got to pay for them. You do not get energy gains without investment, without expense. You have to pay for them.

And I am not talking about putting it in the budget of the United States. I agree with my friends who say we have budgetary problems, do not look at the budget of the United States to find the answers. But there are a lot of policy things that we can do that induce those changes in the marketplace so that the changes take place.

That is the challenge this committee has, and I know each of you gentlemen in your own way has contributed to the public dialogue in a very affirmative way on the energy question, but I hope you will begin to broaden that dialogue by saying it interacts with other policies.

We need ANWR; the threat to our environment is minimal. We need Yucca Mountain built. The threat to our environment is almost zero. We need new nuclear power plants in this country—the least polluting source of energy that we have today. We need electric transportation in the Los Angeles basin. That is a lot more economically efficient than it is to try to force a Clean Air Act across the entire 50 States that has no relevance, except in the major metropolitan areas of our country.

And we need to have people like yourselves, who know the energy industry well and the energy policy questions very well, to say, to point out where they intersect with and interact with other policy questions, so that the American public begins to say to the Congress, get your act together and do what is right.

Congress gets away with murder. I am retiring, I can say that. But if the American public really knew how bad this place is, they would throw the whole bunch of us out. That is partly your fault, partly our fault, partly the public's fault, because we all try to hide the cost of policy choices.

Put an energy tax onto the budget, but exempt home heating oil because of the political effects in New England. Great national policy.

Thank you, Mr. Chairman.

Senator **Bingaman**. Gentlemen, thank you very much. We will keep the hearing record open for 30 days to permit witnesses to respond to any questions. Thank you all for being here. I think the hearing has been useful.

[Whereupon, at 12:20 p.m., the hearing was adjourned.]

APPENDIXES

APPENDIX I

Responses to Additional Questions

CAMBRIDGE ENERGY RESEARCH ASSOCIATES,
Cambridge, MA, November 15, 1990.

Hon. J. BENNETT JOHNSTON,
Chairman, Committee on Energy and Natural Resources, Washington, DC.

DEAR SENATOR JOHNSTON: It is with pleasure that I reply to the questions from Senators Wirth and Bingaman related to the hearing of October 2, 1990.

With kind regards.

Yours sincerely,

DANIEL YERGIN, *President.*

[Enclosure.]

ANSWERS TO QUESTIONS

QUESTIONS FROM SENATOR WIRTH

1. The current Mideast crisis is, at least so far, having less impact on energy use and on the economic performance of Japan and Western Europe because, for the most part, their economies are currently stronger than ours. They are less vulnerable to the price increases because much larger proportions of their retail gasoline prices are tax—meaning that the proportional increase in the overall price is less.

6. The much higher energy taxes in Japan and Western Europe are not completely the same in their impact as oil import fees. Products are not evenly taxed, and the taxes do not lead to higher prices for domestic producers.

7. It's too soon to compare the economic effects of the oil price bust to the current increase—save to say that the decline of the mid-1980s gave a boost to overall economic growth and dampened inflation, while hitting hard the economy of the Southwest. The current increase works in the opposite direction—promoting recession and fueling inflation.

12. In general, we should pursue a broad agenda of energy research.

14. U.S. companies are actively seeking to participate in a liberalized or even privatized Soviet oil industry. One of the biggest obstacles is the political disorganization of the Soviet Union. The companies are struggling with the question "Who's in charge there?"

QUESTIONS FROM SENATOR BINGAMAN

1. It is not at all clear right now what a transition from oil would look like—especially in the transportation system. We have a massive investment in an oil-based civilization. It can be changed at the fringes. But a wholesale conversion would require a great deal of technological progress—and a lot of money.

2. The Japanese proved more adept at pursuing conservation, even though they had less fat to cut. The Japanese responded with a sense of national cohesion and common interest. In the United States, our interests are divided by region and between producers and consumers, and suspicion and hostility appear to be endemic. The value of coordination though the mechanism of the IEA is once again being demonstrated.

3. Yes, since there is only one oil market, we will be susceptible to price swings even if we reorient our imports.

4. Using the SPR can help mitigate the natural human tendency to hoard in a crisis or in anticipation of worse to come.

5. Oil prices have since August 1990 reflected psychology and fear as well as the physical fundamentals of supply and demand.

6. OPEC has taken on the role formerly played by the Texas Railroad Commission.

7. How can we get more conservation? We can "urge" it, we can "regulate" it, or we can "tax" it into existence. Each of these approaches arouses much domestic political contention.

QUESTIONS BY SENATOR WIRTH

FOR DR. GIBBONS

1. What key areas of research should we be focusing government research on in order to increase the economic and logistical practicality of natural gas powered vehicles as an alternative to gasoline and diesel powered vehicles?

2. What possibilities are there for improving the fuel storage capacity of natural gas vehicles?

3. What possibilities are there for reducing the cost or tailoring the design of compressor systems for vehicle fueling?

4. Are there sensible steps we could take to increase the efficiency of refining which would appreciably decrease our oil demand? Would limiting the octane level of gasoline, or requiring the use of non-petroleum octane enhancers, lead to reduced petroleum demand? How large a contribution could this make?

FOR ALL THE WITNESSES

1. What effect do you see the provisions of the recent Bush-Congressional Leadership Budget Proposal have on energy use or energy production in this country? Specifically, what effects would the 10-cent gasoline tax, the 2 cent petroleum product tax, and the assorted oil and gas tax incentive proposals have on energy consumption or energy production? Please try to quantify their effects.

2. What would the effect of an oil import fee of $5.00 per barrel be on energy consumption and energy production in the U.S.? Do you think that such a fee is a good idea, and why do you hold that opinion?

3. Would an oil import fee be more or less effective in reducing oil imports than the tax incentives proposed by the President?

4. What sorts and levels of energy taxes are levied by our economic competitors, especially Germany and Japan?

5. What effect has the current Mideast crisis had on energy use and on the economic performance of Japan, and Western Europe? Have they experienced the same price increases we are seeing? Are their economies more or less vulnerable to these price increases, and what is the basis of their difference from the U.S. in this regard?

6. Aren't the high energy taxes levied by Japan and Western Europe, in effect, oil import fees?

7. How do the effects on the U.S. economy of the oil price bust in the '80's compare with the effects of the current price increase?

8. Do you support the idea of maintaining a floor price for oil, to buffer the negative effects of both swift drops and swift increases in oil prices? What do you think an appropriate level for such a floor should be?

9. Do you support increasing the CAFE standards for automobiles and light trucks sold in the U.S.? Is there any other action as cost-effective for reducing U.S. oil demand? Is there any other option with potential for greater effect in reducing U.S. oil demand?

10. Are there sensible steps we could take to encourage the replacement of oil-burning power plants, which still are quite common on the east and west coasts? What are they?

11. Are there sensible steps we could take to reduce our use of oil as a heating fuel, either through substitution or increased efficiency? What are they?

12. Have the increases in oil prices been reflected in similar increases in other energy prices? What has suppressed increases in other energy prices? If our inability to substitute other energy sources easily for oil is a major factor in the price volatility of oil, shouldn't we be giving greater emphasis to research and development of long-term substitutes for oil, such as alternative motor fuels; finding ways to get people to switch from oil heat; and finding ways to get utilities to replace oil-

fired power plants? Do you have any specific suggestions as to how best to pursue such ends?

13. Since natural gas is the fuel most easily substituted for oil at this point, shouldn't we have a policy of protecting our natural gas supplies? In light of the potential for natural gas to displace oil, do you believe that the recent DOE decision to license a project to export Alaska North Slope natural gas to the Pacific Rim is in the best interest of the nation?

14. How can the United States and U.S. companies best take advantage of the potential of the Soviet Union to increase its oil production?

15. Do you believe the President should be given additional authority to institute emergency oil allocations? What sort of additional authority would you advocate?

Questions by Senator Bingaman

Transition From an Oil Economy:

If the United States decided as a matter of national energy policy to displace oil with other fuels where possible, how long would this transition take?

What factors would dictate the pace of this transition?

What would be the costs associated with this transition?

Other Countries' Energy Policies:

In formulating a national energy policy for the United States, what can be learned from the energy policy experience of other developed countries?

To what extent do political, cultural and economic differences between the United States and other countries affect the relevance of other countries' energy policy experiences for purposes of formulating United States energy policy?

To what extent should United States energy policy be coordinated with the energy policies of our allies?

Energy Security and Source of Supply:

Even if the United States could achieve greater security of supply by shifting its sources of imported oil, wouldn't we still be vulnerable to price swings due to the interdependence of world oil markets?

Supply Hoarding and Panic Buying:

What can be done to check "artificial" demand for oil caused by the inclination to build stocks and "top off the tank" in response to market uncertainties?

Speculation and Price Volatility:

The past two months have demonstrated the linkage between the futures market, the spot market, wholesale contract markets and retail prices for refined products. We have also witnessed great price volatility.

Is this situation where prices appear to bear no relation to supply and demand fundamentals beneficial to the nation's economy or in terms of energy policy?

Is There a Free Market for Oil?

Seventy-seven percent of the world's crude oil reserves are held by the OPEC nations and 63 percent of the world's reserves are located in the nation's surrounding the Persian Gulf. In the first half of 1990, the OPEC nations accounted for 51 percent of no-Communist world oil production and 39 percent of total world oil production.

Given this concentration of both reserves and production, is free trade in the oil market really possible? If not, how should this affect the formulation of United States energy policy?

Energy Efficiency and Conservation:

What can be done to promote energy efficiency and conservation?

What can be done to ensure that energy efficiency gains and conservation achieved in response to high oil prices are not lost once oil prices return to lower levels?

Can energy efficiency and conservation be "enforced" or must we rely wholly on market forces and voluntary choices made by consumers?

Diversification of Supply:

At the hearing it was suggested by several witnesses that it would be beneficial for the United States to diversify its sources of supply of imported oil.

How as part of a national energy policy can the federal government mandate, or at least strongly encourage, that oil companies, refiners and purchasers of refined products diversify their sources of imported oil and refined products?

Use of the Strategic Petroleum Reserve:

At the hearing Dr. Gibbons suggested that the SPR be used to balance both price increases and price collapses caused by extraordinary events.

Would Dr. Yergin, Mr. Martin and Mr. Schuler respond as to whether this proposal makes good sense from an energy policy perspective.

How large would the SPR have to be in order to be effective in the role suggested by Dr. Gibbons?

While not explicitly using SPR purchases as a price support mechanism, would it make sense to mandate that SPR purchases must in the first instance be from domestic producers?

CONGRESS OF THE UNITED STATES,
OFFICE OF TECHNOLOGY ASSESSMENT,
Washington, DC, October 31, 1990.

Hon. J. BENNETT JOHNSTON,
Chairman, Committee on Energy and Natural Resources, Washington, DC.

DEAR MR. CHAIRMAN: Enclosed are responses to the follow-up questions I received from Senators Wirth and Bingaman concerning the October 24 hearing before your committee on U.S. energy policy. Thank you again for the invitation to participate in the hearing.

Sincerely,

JOHN H. GIBBONS, *Director.*

QUESTIONS FROM SENATOR TIMOTHY E. WIRTH FOR DR. GIBBONS

Question 1. What key areas of research should we be focusing government research on in order to increase the economic and logistical practicality of natural gas powered vehicles as an alternative to gasoline and diesel powered vehicles?

Answer. The major automobile manufacturers have tended to focus their research on alternatively-fueled engine/vehicle systems on methanol vehicles, since methanol (particularly as M85, a mixture of 85 percent methanol and 15 percent gasoline) is viewed by the companies as a more likely contender than natural gas for displacing gasoline. Thus, research on natural gas vehicle systems is not as advanced as that for methanol. Consequently, general research aimed at producing highly efficient, dedicated natural gas vehicles as well as improved mass-produced dual-fuel vehicles (current dual-fueled vehicles are retrofit from gasoline vehicles) would be useful to increase the economic and logistical practicality of natural gas as a vehicle fuel. Priority areas are higher pressure fuel tanks (or alternative means of increasing storage capacity, discussed below), to increase range; engine design for a dedicated vehicle; and computer controls and engine design for a dual-fuel vehicle. We note that, with the possible exception of materials research for the fuel tanks, the auto manufacturers and suppliers are the most appropriate source for the necessary research, and any policies to stimulate natural gas use in vehicles should be designed to stimulate the necessary research. We do not view the desired advances as particularly difficult or exotic, and the companies should be quite capable by themselves of solving any remaining engine problems.

Question 2. What possibilities are there for improving the fuel storage capacity of natural gas vehicles?

Answer. At the pressure capability of current commercial fuel tanks for natural gas, a unit volume of natural gas will allow a vehicle to travel about one quarter as far as would a similar volume of gasoline. (More precisely, a 3000 psi pressure capability yields a natural gas:gasoline volume ratio of about 4.2:1 assuming that the natural gas pressure vessel itself adds about 25 percent to the total volume of fuel storage space.) This creates a range problem for natural gas-powered vehicles unless they are willing to sacrifice significant storage space to the fuel tanks.

There are basically three ways to improve the fuel storage capability of natural gas vehicles: increase pressure, substitute some form of absorbent storage, or substitute liquefied natural gas for compressed natural gas.

> Increasing pressure involves substituting a higher-strength material, e.g. carbon-wrapped aluminum, for less-strong (and cheaper) fiberglass- or kevlar-wrapped aluminum. Further research and development in materials and manufacturing systems for the materials may allow higher pressures (4500 psi is attainable with carbon-wrapped vessels) at competitive prices. An important drawback to higher pressures is increased expense and difficulty of filling the tanks. Typical pressures available in residential distribution systems are considerably lower, so recompression would be necessary.

Adsorbent storage involves the use of materials that adsorb natural gas onto a porous solid under pressures lower than that used for standard pressurized storage. Research on such systems are in their infancy and are speculative, implying a potential government role. The Gas Research Institute has sponsored some research on this type of storage.

Liquefied natural gas or LNG is natural gas held at extremely low temperature -258°F); it has an energy/volume density greater than twice that of CNG at 3000 psi. In terms of storage, LNG is similar to methanol, that is, it will require about twice the storage capacity of gasoline to attain the same range. LNG storage tanks that appear practical for vehicular use have been demonstrated, and filling station designs have been proposed.

Question 3. What possibilities are there for reducing the cost or tailoring the design of compressor systems for vehicle fueling?

Answer. A successful natural gas vehicle network could work with home compressors (designed to slowly fill a vehicle's tank overnight), larger fleet-oriented compressors designed to slowly fill several vehicles, and powerful service station compressors designed to quickly fill a vehicle's storage tank quickly enough to avoid major inconvenience . . . or any combination of the three systems. We are not familiar enough with the current state-of-the-art of these systems or the potential for improvement to recommend at this time measures for reducing their cost or improving their performance.

Question 4. Are there sensible steps we could take to increase the efficiency of refining which would appreciably decrease our oil demand? Would limiting the octane level of gasoline, or requiring the use of non-petroleum octane enhancers, lead to reduced petroleum demand? How large a contribution could this make?

Answer. The efficiency of gasoline refining, or refining in general, can be increased by changing product mix, changing the specifications of the products, using different crude oil inputs, or making technical improvements to the refining process. Most of these options do not offer a promising government role. Changing product mix clearly is a market function. Using different crude oil inputs may be possible, but the price of crude is closely tied to the ability of refineries to efficiently use the crude to produce desired products; more "efficient" crude will be more expensive, and generally it is fair to assume that refinery operators select their crude to obtain a combination of yield and refining costs that is optimum for their technology mix. It is further safe to assume that refiners and chemical engineering firms are continually searching for technological improvements, e.g. new catalysts, that will boost refining efficiency; it is difficult to envision a strong government role in helping them to find such technologies.

Changing the specifications of products, especially gasoline, can change the efficiency of refining. For example, limiting octane levels of gasoline can reduce the energy necessary to produce the gasoline and increase product yield from a barrel of crude. However, lower octane gasoline implies lower compression ratios—and reduced fuel efficiency—in automobile engines. Because of the tradeoff between octane and engine efficiency, it is not at all clear that the net effect of lowering octane levels would be a savings in crude oil. However, many analysts claim that a large percentage of gasoline buyers purchase a higher octane gasoline than their cars require, creating higher profits for refiners but increased energy use and crude demand. This implies that a program to reduce this type of "misfueling" could save oil. We have not examined the potential quantitative effects of such a program.

Requiring the use of non-petroleum octane enhancers would lead to reduced petroleum demand, though at the potential expense of higher gasoline costs and prices and increased imports of certain chemicals. For example, ethyl alcohol additives not only act as an octane enhancer, but also as a fuel. OTA has not analyzed the effects of the most recent congressional proposals regarding gasoline reformulation. However, David Gushee, Senior Specialist in Environmental Policy with the Congressional Research Service, recently computed the effect of proposed standards for including high levels of oxygenates in gasoline (Gushee, D.E., "Impact of Regulatory Changes Affecting Gasoline on Import Dependence," Congressional Research Service Memorandum, August 31, 1990, can be obtained from the author at 77228). Gushee calculates that proposals for about 3 percent oxygen (2.7 percent in the House, 3.1 percent in the Senate) in carbon monoxide nonattainment areas during the winter and further oxygenate requirements for oxygenates in the worst ozone nonattainment areas would require "MTBE at 15% or so and ethanol at 10% or so . . . in 40% or so of the domestic market, reducing the demand for gasoline components derived directly from crude oil by 5 to 6%." According to the Energy Information Administration, gasoline represents about 43 percent of U.S. total petroleum product demand. Thus, Gushee's conclusions imply that the oxygenate requirements would reduce total petroleum product demand by a bit over 2 percent.

The current conference agreement calls for 2.7 percent oxygenate in CO nonattainment areas and 2.0 percent oxygenate in the worst ozone nonattainment areas. This should not change the general conclusion above. It is important to note, however, that the actual level of petroleum substitution depends on a number of uncertain factors:

the mix of MTBE, ETBE, and ethanol used as oxygenates
the number of other areas (beyond California) that opt into the reformulated gasoline requirement
the use of oxygenates in areas outside of the nonattainment areas (this in turn depends on availability of oxygenate supplies and changes in oxygenate prices).

QUESTIONS FROM SENATOR TIMOTHY E. WIRTH FOR ALL THE WITNESSES

Question 1. What effect do you see the provisions of the recent Bush-Congressional Leadership Budget Proposal have on energy use or energy production in this country? Specifically, what effects would the 10-cent gasoline tax, the 2 cent petroleum product tax, and the assorted oil and gas tax incentive proposals have on energy consumption or energy production? Please try to quantify their effects.

Answer. The proposed 12 cents per gallon tax on gasoline would likely reduce demand by several tens of thousands of barrels per day, primarily through reduced driving. In the long term, some efficiency effects would show up in the form, for example, of new car purchases being more sensitive to mpg, but considerably higher taxes would be necessary to have a significant impact on purchasing decisions. For example, at 10,000 miles per year with a car that gets 20 mpg, the increased annual cost with a 12 cent additional tax is around 60 dollars. OTA has not attempted to calculate the precise effect, but the Department of Energy has, presumably by applying fairly standard estimates of the price sensitivity of oil demand.

We are less optimistic about the effects on production of new oil and gas tax incentives. We suspect that most production companies will view the incentives as relatively minor factors in their drilling and production decisions, and base their behavior primarily on their long-term oil price outlook.

Question 2. What would the effect of an oil import fee of $5.00 per barrel be on energy consumption and energy production in the U.S.? Do you think that such a fee is a good idea, and why do you hold that opinion?

Answer. It is likely that the effects of such a fee on stimulating domestic production, given recent oil prices in the $30-40/barrel range, would be a quite small increase, perhaps a few tens of thousands of barrels/day or less. It would probably result in a moderate decrease in consumption, somewhat smaller than OTA's forecast in 1987. Our expectation of a low production response is based on our view that the current price is sufficient to stimulate development of most available domestic opportunities, and another presumably temporary $5/barrel shouldn't change this equation. If, however, producers felt that the $5/barrel fee was permanent, this would change their behavior because it is their long-term price expectations that are the main driver of drilling and production behavior. Most producers would likely be skeptical that the fee would be maintained if the current Gulf crisis was defused and oil prices fell back to previous low levels.

While OTA has analyzed this issue in depth, the Department of Energy's 1987 Energy Security report calculated the effect of a $5.00 fee as adding 240,000 barrels/day to domestic production and reducing consumption by 500,000 barrels/day within about 5 years. However, these estimates were based on an assumption of an extremely low base price for oil—about $15/barrel. The report does, however, give a good synopsis on the positive and negative aspects of an oil import fee. In brief, such a fee has the following benefits and costs:

BENEFITS

Increased domestic oil production and reserve additions.
Reduced oil imports and some moderating effect on world oil prices.
Reduced vulnerability to a future supply disruption.
Increased oil-related employment.
Import fee receipts.

COSTS

Increased energy costs.

Reduced economic activity.

Net decrease in general revenues (import fees outweighed by lost income tax receipts).

Reduced local employment nationwide.

Question 3. Would an oil import fee be more or less effective in reducing oil imports than the tax incentives proposed by the President?

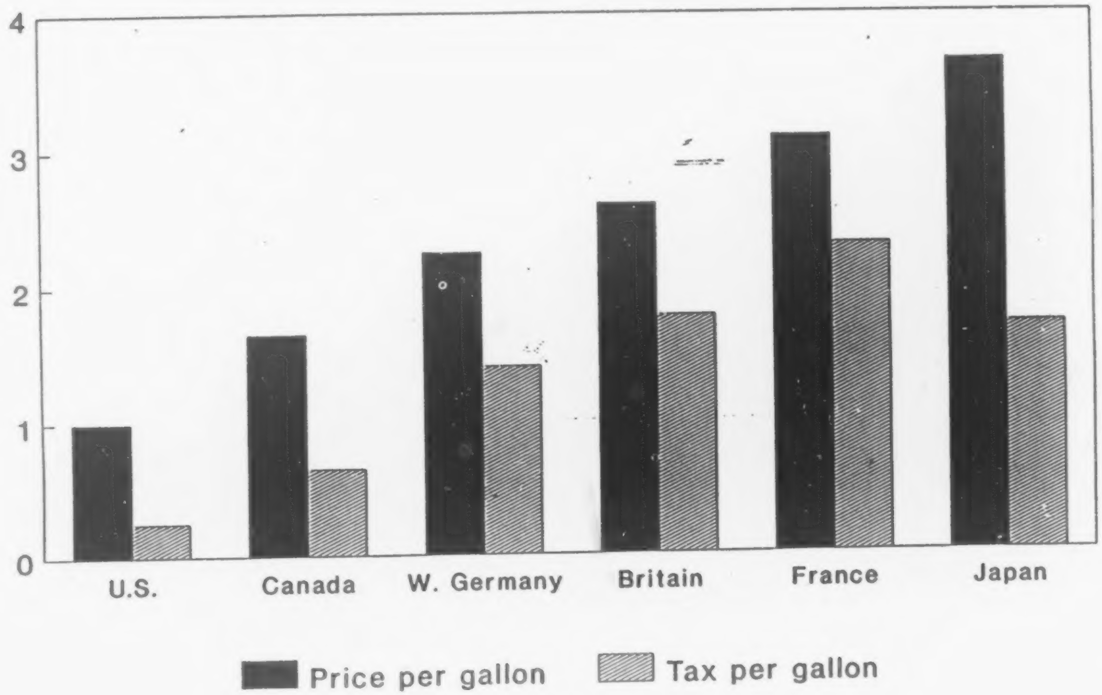
Answer. Given time, it is easier to reduce oil consumption than it is to increase domestic production by an equal amount. An oil import fee will obtain most of its import reduction benefits through reduced consumption, with increased production playing a smaller role. Tax incentives will cause only a modest increase in production and produce no change in consumption. The oil import fee should be a better weapon to reduce oil imports.

Question 4. What sorts and levels of energy taxes are levied by our economic competitors, especially Germany and Japan?

OTA has not previously conducted a comparative study of energy consumption in the United States and its economic competitors, which have very different energy tax systems. However, the attached figure does show the taxes on gasoline of Canada, West Germany, Britain, France, and Japan as of about a year ago. As is widely known, most of the industrial world has much higher gasoline taxes than does the United States. This implies that a gradual rise in gasoline taxes should not put the United States at a disadvantage vis-a-vis these economic competitors. In fact, it could nudge us toward a more energy-efficient economy, better able to handle an uncertain future.

Gasoline Price with Tax

(dollars per gallon)



SOURCE: BUSINESS WEEK

Question 5. What effect has the current Mideast crisis had on energy use and on the economic performance of Japan, and Western Europe? Have they experienced the same price increases we are seeing? Are their economies more or less vulnerable to these price increases, and what is the basis of their difference from the U.S. in this regard?

Answer. Product price increases have actually been much higher in Japan and Western Europe. Crude oil prices have followed world market prices in all countries. Our allies are much more dependent on foreign sources than the United States is. The United States is still a very large producer of oil. U.S. oil import dependence is on the order of 50% while Japanese oil import dependence is over 90%.

Question. 6. Aren't the high energy taxes levied by Japan and Western Europe, in effect, oil import fees?

Answer. Since there is no domestic production of oil in these countries, the distinction between oil import fees and gasoline taxes, for example, is less important.

Question 7. How do the effects on the U.S. economy of the oil price bust in the '80's compare with the effects of the current price increase?

Answer. The market behaved exactly as expected. The trends toward improved energy efficiency stalled in the late 1980s. Total vehicle miles travelled, for example, grew substantially, offsetting the fuel economy gains of the 1970s, resulting in once again increasing gasoline consumption. Consumers began to select performance and amenity rather than fuel economy in new car purchases. It is too early to tell what the implications of the current price increase will be.

Question 8. Do you support the idea of maintaining a floor price for oil, to buffer the negative effects of both swift drops and swift increases in oil prices? What do you think an appropriate level for such a floor should be?

Answer. A floor price for oil is one means of stabilizing swift drops in price, thus reducing risk for more speculative exploration and development. While we have not completed an analysis of this issue in any depth, many analysts agree that a floor price in the $20-25 range would be appropriate.

Question 9. Do you support increasing the CAFE standards for automobiles and light trucks sold in the U.S.? Is there any other action as cost-effective for reducing U.S. oil demand? Is there any other option with potential far greater effect in reducing U.S. oil demand?

Answer. CAFE has arguably been one of the most important energy policy successes coming out of the 1970s. New car fuel economy in the U.S. is on a par with that of countries in Western Europe and Japan, which have two and three fold higher prices for gasoline. The drawback, of course, is that continued low fuel prices lead to increased miles traveled and, hence, increased gasoline consumption. Also, loopholes in the regulations, like exemptions of light trucks and minivans, have contributed further to stalled fuel economy improvements in these vehicles. As gasoline prices increase, technology can increasingly provide cost-effective fuel economy improvements.

Question 10. Are there sensible steps we could take to encourage the replacement of oil-burning power plants, which still are quite common on the east and west coasts? What are they?

Answer. The U.S. still burns around 700,000 mbd of oil in electric power production—no increase from 1983. Until the recent price rise, some utilities were actually considering a move back to oil for some plants. Most of these plants are in peaking applications and in areas without access to natural gas. In New England, for example, increased access to natural gas would prompt utilities to back out of oil very quickly. The same probably holds for Florida as well, with perhaps even the further opportunity to try photovoltaics for peaking power in select southern locations.

Question 11. Are there sensible steps we could take to reduce our use of oil as a heating fuel, either through substitution or increased efficiency? What are they?

Answer. State-of-the-art oil burners are very efficient. Accelerating the turnover or up-dating of capital stock of older, less efficient burners would be very productive in backing out oil. Natural gas and electricity technologies (heat pumps) are also now very competitive substitutes if capital turnover can be accelerated. The oil used for heating fuel is very similar to diesel oil and could be utilized as a transportation fuel. Current residential and commercial consumption of oil (residual, distillate, kerosene, and lpg) is about 1.4 million barrels per day.

Question 12. Have the increases in oil prices been reflected in similar increases in other energy prices? What has suppressed increases in other energy prices? If our inability to substitute other energy sources easily for oil is a major factor in the price volatility of oil, shouldn't we be giving greater emphasis to research and development of long-term substitutes for oil, such as alternative motor fuels; finding ways to get people to switch from oil heat; and finding ways to get utilities to replace oil-fired power plants? Do you have any specific suggestions as to how best to pursue such ends?

Answer. Alternatives to oil are a must, but they should be developed with a balance of concern for economic health, environmental quality, and energy security. For example, methanol and/or ethanol are logical substitutes for gasoline. The short-term feedstock for methanol production is likely to be imported natural gas. However, in the long run, research and development also needs to focus on the likely transition to a new feedstock after natural gas reserves begin to deplete. The logical next choice is coal unless the environmental concerns over global warming are addressed seriously, in which case biomass is important. Also, a transition to electric cars would allow a range of new fuels to be used to power the fleet, since electricity production itself is extremely fuel flexible.

Question 13. Since natural gas is the fuel most easily substituted for oil at this point, shouldn't we have a policy of protecting our natural gas supplies? In light of the potential for natural gas to displace oil, do you believe that the recent DOE decision to license a project to export Alaska North Slope natural gas to the Pacific Rim is in the best interest of the nation?

Answer. The natural gas resources of the north slope of Alaska are very expensive compared to other sources the U.S. can draw upon. While we have not examined this specific proposal in depth, it is certainly conceivable that the most efficient use of this resource is for export to the Pacific Rim.

Question 14. How can the United States and U.S. companies best take advantage of the potential of the Soviet Union to increase its oil production?

Answer. The vast oil resources of the Soviet Union, their need for western technology and economic aid, U.S. technology, and the U.S. need to diversify its sources of oil imports all comprise the right ingredients for a cooperative development of those resources. In particular, a portion of the oil production in exchange for U.S. economic aid and technology would benefit everyone. There are strong arguments to favor U.S. encouragement of industrial joint ventures and cooperative research and development.

Question 15. Do you believe the President should be given additional authority to institute emergency oil allocations? What sort of additional authority would you advocate?

Answer. The President already has considerable authority in this area. The problem is that most emergency actions do not work very well. The U.S. energy system is very resistant to rapid changes. Nonetheless, some steps could improve the situation. For example, the SPR is important but honoring our commitments to the IEA in the event of an emergency makes the SPR much less effective domestically. Convincing other IEA countries to build their emergency stockpiles and to coordinate their use in the event of an emergency could have enormous leverage in world oil markets, at least in the short term.

QUESTIONS FROM SENATOR JEFF BINGAMAN

TRANSITION FROM AN OIL ECONOMY

Question 1. If the United States decided as a matter of national energy policy to displace oil with other fuels where possible, how long would this transition take?

Answer. Some steps could be undertaken immediately, e.g., some fuel switching in industry and electric utilities where natural gas is available. Others such as developing a delivery infrastructure for alternative transportation fuels could take decades to complete. We discuss this subject in great detail in the enclosed report,"Replacing Gasoline: Alternatives for Light-Duty Vehicles," * October 1990. The timing would depend also on which fuel source we chose to move to. For natural gas, the transition could be quicker because technology for conversion to alternative fuels is less complex and has fewer environmental problems. On the other hand, much, if not most of the natural gas would be imported and thus not as great an energy security benefit as we might hope for. There may be opportunities to further develop natural gas sources in Canada, Mexico or other areas outside the Middle East, but by far the cheapest sources of natural gas are in Arab OPEC countries. If we turned to gas or methanol from coal, we would reap a large energy security benefit if we could keep costs down. However, we would face substantial lead times, e.g. several decades, not only because of the technical challenges but also because rushing development of coal technologies could have unacceptable environmental impacts.

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* Retained in committee files.

Question 2. What factors would dictate the pace of this transition?

Answer. We discuss this in detail in "Replacing Gasoline: Alternatives for Light-Duty Vehicles," October 1990.

Question 3. What would be the costs associated with this transition?

Answer. We discuss this in detail in "Replacing Gasoline: Alternatives for Light-Duty Vehicles," October 1990.

OTHER COUNTRIES' ENERGY POLICIES

Question 4. In formulating a national energy policy for the United States, what can be learned from the energy policy experience of other developed countries?

Answer. Some examples: Swedish residential building technology is a prize and indicates that energy policy is intimately linked to other economic and social policy. Energy policy cannot be formulated in isolation and must have a long term vision. No country has all the pieces right, but many have done better than the U.S. Standards and prices can make a big difference.

Question 5. To what extent do political, cultural and economic differences between the United States and other countries affect the relevance of other countries' energy policy experiences for purposes of formulating United States energy policy?

Answer. They can have a very important influence. Japanese live in smaller houses with very little central heating or cooling. British use much smaller refrigerators. Patterns of urbanization dramatically affect patterns of energy consumption. Family size, regional demographics, migration policy, trade policy, and many other features of countries can have a dramatic affect. A recent publication by the U.S. EIA entitled "Indicators of Energy Efficiency: An International Comparison" illustrates many of these differences.

Question 6. To what extent should United States energy policy be coordinated with the energy policies of our allies?

Answer. In the short term, such as in emergency preparedness for an oil supply disruption, the coordination in the use of stockpiles can be very effective, if not essential, and should certainly be an objective of international agreements with other IEA countries. In the longer term, strategies to address global environmental issues, such as global warming, will require long-term, sustained international coordination of energy policy that has never occurred in human history.

ENERGY SECURITY AND SOURCE OF SUPPLY

Question 7. Even if the United States could achieve greater security of supply by shifting its sources of imported oil, wouldn't we still be vulnerable to price swings due to the interdependence of world oil markets?

Answer. Yes, but promoting diversity in supply sources slows the returning dominant influence of OPEC countries over world oil markets. We discuss the energy security issue in detail in Replacing Gasoline: Alternatives for Light-Duty Vehicles, October 1990.

SUPPLY HOARDING AND PANIC BUYING

Question 8. What can be done to check "artificial" demand for oil caused by the inclination to build stocks and "top off the tank" in response to market uncertainties?

Answer. Any measures to buffer the level and rate of change of energy price would be very important, along with providing some assurance of continuity of supply.

SPECULATION AND PRICE VOLATILITY

The past two months have demonstrated the linkage between the futures market, the spot market, wholesale contract markets and retail prices for refined products. We have also witnessed great price volatility.

Question 9. Is this situation where prices appear to bear no relation to supply and demand fundamentals beneficial to the nation's economy or in terms of energy policy?

Answer. In terms of energy policy, the recent price volatility observed in international oil markets can be traced to non-market geopolitical forces that have overwhelmed market forces. Any price volatility affects the economy and exploring mechanisms to reduce volatility are important. On the other hand, the changes in the nature of the oil market over the last decade, including the advent of the futures market and the new focus on spot sales, have been generally beneficial to the U.S. economy because they reduce U.S. and Western vulnerability to embargoes and allow market signals to be passed on very quickly to customers—speeding up necessary economic adjustments to changes in oil supply.

IS THERE A FREE MARKET FOR OIL?

Seventy-seven percent of the world's crude oil reserves are held by the OPEC nations and 63 percent of the world's reserves are located in the nation's surrounding the Persian Gulf. In the first half of 1990, the OPEC nations accounted for 51 percent of no-Communist world oil production and 39 percent of total world oil production.

Question 10. Given this concentration of both reserves and production, is free trade in the oil market really possible? If not, how should this affect the formulation of United States energy policy?

Answer. Many energy economists in the United States have at one time or another attempted a response to this question—since it is a central question of U.S. energy policy. It is in part a technology question that hinges on possibilities for oil substitution, reduced demand through efficiency gains, and increased success in finding an producing oil. It is also an economic/trade/foreign policy question that hinges on the policies that encourage moderation in pricing, discouragement of cartellization, and diversification of U.S. dependence on other regions that supply oil.

Oil markets seem to work best when they operate in open, competitive environments. But world oil supplies are concentrated geographically, leading to strong, inherent geopolitical "non-market" influences. Thus one should opt to let the "free market" operate to the extent it can, but be realistic about the need to intervene when non-market factors dominate. That is the reason for the SPR. This concept could be extended to help assure that rapid swings in price (up or down) are buffered by public policies or other actions. Actions to help diversify our sources of imports include, as I noted in my testimony, assistance to the U.S.S.R. for exploration and development of their oil resources in exchange for access to that oil or, similarly, encouragement of heavy oil development in Venezuela.

ENERGY EFFICIENCY AND CONSERVATION

Question 11. What can be done to promote energy efficiency and conservation?

Answer. Most important, perhaps, is getting the prices right, i.e., establishing energy prices that adequately reflect all of the costs incurred by society in the course of consuming that energy. These costs include environmental and other external costs such as ensuring supply availability. Using prices that reflect these costs is the most efficient way of encouraging efficiency. Other mechanisms such as making information available, providing financial incentives, promulgating efficiency regulations, and a host of others are possible. We have discussed them in a number of past reports including: Energy Use and the U.S. Economy, June 1990; New Electric Power Technologies: Problems and Prospects for the 1990s, July 1985; Industrial Energy Use, June 1983; Industrial and Commercial Cogeneration. February 1983; Increased Automobile Fuel Efficiency and Synthetic Fuels: Alternatives for Reducing Oil Imports, September 1982; and Energy Efficiency of Buildings in Cities, March 1982. In general, the signal of total cost should be clear in the price and regulations (or standards) should be consistent with the intended price signals so that they are mutually reinforcing.

Question 12. What can be done to ensure that energy efficiency gains and conservation achieved in response to high oil prices are not lost once oil prices return to lower levels?

Answer. Efficiency improvements that are undertaken as investments in technology or other permanent structural changes in the economy are mostly permanent changes. And while in some cases they may take a decade or more to have their effect on the economy's energy characteristics they often have dramatic effect. Industrial energy efficiency investments, building efficiency improvements (both in new construction and retrofits), and appliance efficiency standards are all examples of investments that happen very slowly but ultimately have large impacts.

Question 13. Can energy efficiency and conservation be "enforced" or must we rely wholly on market forces and voluntary choices made by consumers?

Answer. In some instances if we can't get market forces to adequately reflect the substantial "external" costs of energy, enforced savings through standards, surcharges, or other regulations have been and could continue to be very effective. Appliance efficiency standards, for example, have worked very well. Fuel economy standards for automobiles, likewise, have contributed to dramatic improvements in average fleet fuel economy despite continued low gasoline prices. There is much that can be done at present prices which would spur the economy, save money, and cut down on the extraordinary export of U.S. dollars to buy foreign oil.

DIVERSIFICATION OF SUPPLY

At the hearing it was suggested by several witnesses that it would be beneficial for the United States to diversify its sources of supply of imported oil.

Question 14. How as part of a national energy policy can the federal government mandate, or at least strongly encourage, that oil companies, refiners and purchasers of refined products diversify their sources of imported oil and refined products?

Answer. I suppose encouraging more diverse portfolios of resource supplies for individual companies is possible, but at the company level it is less important than it used to be because of the spot market for crude oil. Rather, the major problem is that if we get cut off from one supplier refineries need to be flexible enough to handle alternative crudes. Getting the crude itself is less of a problem. As a matter of national policy, however, developing alternative supplies, e.g., the U.S.S.R. or Venezuela, to diffuse the supply concentration is an important option. It need not be done through mandates, however. Encouraging cooperative development through government-to-government negotiations to open doors for technology transfer and capital in exchange for access to oil in those countries could be very effective. Such activities can also make important contributions to other foreign policy objectives.

USE OF THE STRATEGIC PETROLEUM RESERVE

At the hearing Dr. Gibbons suggested that the SPR be used to balance both price increases and price collapses caused by extraordinary events.

Question. Would Dr. Yergin, Mr. Martin and Mr. Schuler respond as to whether this proposal makes good sense from an energy policy perspective.

How large would the SPR have to be in order to be effective in the role suggested by Dr. Gibbons?

Answer. Certainly a billion barrels, but more importantly the strategy needs be coordinated with the stocks of other nations in the IEA. Only then will the overall stockpile be large enough to be viewed as a tool for discipline in oil market prices.

Question. While not explicitly using SPR purchases as a price support mechanism, would it make sense to mandate that SPR purchases must in the first instance be from domestic producers?

Answer. Why? Shouldn't the SPR be filled with the lowest cost source from wherever that source is located and is available? The object is to buy where and when price is low and release when price runs up due to non-market influences.

WASHINGTON, DC, *November 13, 1990.*

Hon. J. BENNETT JOHNSTON,
Chairman, Committee on Energy and Natural Resources, U.S. Senate, Washington, DC.

DEAR MR. CHAIRMAN: It was a pleasure to testify before the Committee on October 2 and explore new energy policy strategies in light of the Gulf situation. I am pleased to submit for your review responses to the questions posed by Senators Bingaman and Wirth. If I can be of further assistance to the Committee, please do not hesitate to call upon me.

Sincerely,

WILLIAM F. MARTIN.

[Attachment.]

RESPONSES TO QUESTIONS FROM SENATOR TIMOTHY WIRTH

Question: What effect do you see the provisions of the recent Bush-Congressional Leadership Budget Proposals have on energy use and on energy production in this country? Specifically, what effects would the 10-cent gasoline tax, the 2-cent petroleum product tax, and the assorted oil and gas tax incentive proposals have on energy consumption or energy production? Please try to quantify their effects.

Answer: The budget agreement recently passed by Congress and signed into law calls for a 5 cent tax per gallon of gasoline and provides tax breaks for oil and gas developers that will gradually diminish after the price of oil reaches $28 a barrel and be eliminated when the price reaches $34 a barrel.

When I was at the Department of Energy in 1987, we did an analysis of the effects of a gasoline tax in preparation for our report "Energy Security: A Report to the President of the United States." In evaluating a gas tax from a cost-benefit perspective, we identified the following benefits and disadvantages of imposing a tax:

Benefits:

—Decreased gasoline demand, reduced oil imports.

—Reduced payments for oil imports eventually lowers the price of oil in world markets.

—Reduced consumption resulting from higher price of gasoline reduces our vulnerability to a oil supply disruption.

—Increased Treasury revenue and reduced Federal deficit.

Disadvantages:

—Reduced economic activity.

—Increased unemployment.

—Increased inflation.

—Regressive tax, hurts low-income gasoline users.

—Reduces oil industry revenue and profits (also motor vehicle, travel and other industries).

Thus, a gasoline tax reduces U.S. consumption of gasoline products, enhancing our energy security in the process. I would estimate that a 5-cent tax will lower consumption by about 100,000 barrels a day—roughly .8% of our overall oil use.

There is a real economic cost to imposing a tax, however, that goes beyond higher prices at the pump. An increase in gasoline prices shows up in the rate of inflation during the year taxes are enacted and continues in the future. Since some motor fuel is used as an input for other economic activity (trucking transportation, etc.), the increased price of fuel will also be reflected in higher-priced goods and services. DOE's cost-benefit analysis in 1987 found that the macroeconomic loss of a gas tax far exceeds the estimated energy security benefits. Today's oil supply situation of declining domestic production, rising imports, and a world-wide oil industry operating at near-capacity—not to mention the havoc Saddam Hussein's invasion of Kuwait has wrecked on world oil markets—is more tenuous than it was when the Energy Security analysis was conducted. An updated cost-benefit study that addresses the energy security benefits and macroeconomic costs of gasoline taxes in today's uncertain environment would be useful, and may reveal some interesting conclusions.

With regard to the budget's impact on domestic oil production, the energy provisions will have both positive and adverse effects: gasoline taxes, which dampen consumer demand, will hurt the oil industry, while tax incentives during periods of relatively-low priced oil, will provide some security and financial benefits that will encourage production. Current trends in the domestic oil industry—which have exhibited low levels of growth in production and exploration, despite soaring oil prices—demonstrate how important security is as a factor in expanding domestic production. My judgment is that the overall effect of the FY 1991 budget on oil production and exploration—once oil markets return to normal, with prices falling in the low to mid-$20s—will be positive, although modest.

Question: What would the effect of an oil import fee of $5.00 per barrel be on energy consumption and energy production in the U.S.? Do you think that such a fee is a good idea, and why do you hold that opinion?

Answer: Imposing an import fee on foreign crude oil and refined petroleum products that enter the U.S. would raise prices paid for all oil in this country, and this would permit domestic crude producers to operate more profitably. A $5 oil import fee would add approximately 12 cents to the cost of a gallon of gasoline—more than twice that imposed by the gas tax provisions in the FY 1991 budget. As with the case of a gasoline tax, requiring consumers throughout the U.S. to pay higher oil prices will raise costs for all energy and almost everything else throughout the nation's economy, and this would reduce the rate of growth of Gross National Product (GNP) with attendant negative effects on employment, corporate earnings, cost of living/quality of life, and federal tax revenues. Thus, the clear energy security and sectorial benefits must be weighed against substantial economic costs.

In my judgment, in "normal" times such as those prior to Iraq's invasion of Kuwait, a $5 oil import fee would reduce domestic consumption by about 400,000-500,000 barrels per day. In addition, domestic production would increase by approximately 300,000 barrels per day. Thus, the net effect of the import fee would be to reduce U.S. demand for oil imports by about 700,000 barrels per day, representing a measurable gain to our energy security. This benefit must be viewed within the context of macroeconomic costs, however: DOE's analysis in 1987 found that the macroeconomic losses from import fees over the long run far exceeded energy security gains. In-depth current analysis factoring in the increased likelihood of oil supply disruptions that threaten us currently and in the future could provide the foundation to comprehensively examine the costs and benefits of oil import fees given today's market, economic and oil supply situation.

One reservation that I have about imposing an oil import fee in the U.S. is that it would hamper our competitiveness in the international market place. Higher energy prices are passed down to consumers in a variety of forms, making our products more expensive vis-a-vis those of our foreign competitors. In today's challenging economic environment, I wonder whether the U.S. has the "luxury" of pursuing fiscal policies that in effect impose a premium price on U.S.-made goods. In light of these concerns, I would recommend that an alternative proposal be considered instead: reactivating the International Energy Agency's minimum safeguard price mechanism (MSP). The MSP could serve as a world oil floor price which would help encourage greater investment in alternatives to oil, conservation, and oil and gas development in the long run. Under this framework, the U.S. would not be penalized relative to our trading partners should a floor price be instituted. If we are indeed entering an era where our long-term energy security is seriously threatened and policy-makers decide to impose taxes or fees to dampen oil consumption, I believe the MSP deserves careful consideration.

Question: Would an oil import fee be more or less effective in reducing oil imports than the tax incentives proposed by the President?

Answer: An oil import fee of $5 would raise energy prices significantly higher than the tax provisions incorporated in the FY 1991 budget, resulting in a sharper reduction in U.S. oil demand and greater energy security benefits—at a significantly higher economic cost. Oil import fees and gasoline taxes both raise domestic energy prices and transfer income from consumers to the Federal Government, and both reduce demand for petroleum products which, eventually, will exert downward pressure on world oil prices. Fees and taxes that are equivalent—i.e., have the same effect on energy prices—will have similar impact on consumption. Thus, a 5 cent increase in the price of a gallon of gas will reduce U.S. demand for gasoline by about 100,000 barrels per day regardless of whether a tax or an import fee is responsible for the price increase.

There may be a difference in how the two policies effect domestic production, however. An oil import fee is just imposed on imported oil and benefits the U.S. oil industry by raising the price of domestically-produced oil, with the increased revenue passed on to industry. In contrast, a gasoline tax does not favor domestic industry, and would have no positive effect on domestic production. The FY 91 budget does include tax incentives for the U.S. oil industry, however, that will encourage domestic production. A precise comparison of the net effects of an oil import fee and gas taxes/industry incentives on U.S. oil production and consumption—and the costs of pursuing these policies—requires a sophisticated macroeconomic model such as EIA's Future Forecasting System, or DRI's or WEFA's model of the U.S. economy.

Question: What sorts and levels of energy taxes are levied by our economic competitors, especially Germany and Japan?

Answer: This question deserves a detailed answer and I would like to call to the Committee's attention the publications of the International Energy Agency which regularly analyzes and publishes data on energy taxes. The most comprehensive volume, produced annually by the IEA, is "Review of Member Country Energy Policies." This excellent volume is available from the OECD publications office in Washington, D.C.

Question: What effect has the current Mideast crisis had on energy use and on the economic performance of Japan and Western Europe? Have they experienced the same price increases we are seeing? Are their economies more or less vulnerable to these price increases and what is the basis of their difference from the U.S. in this regard?

Answer: The price of oil is set on the world market which all consumers must pay—thus, traders in the U.S., Japan, West Germany, etc. all pay the same price for a barrel of oil. However, since energy products in Europe and Japan are more heavily taxed than in the U.S., the relative price increase on end products would be less in these countries than in the U.S., which may—perceptually at least—cushion the impact of the recent price hikes.

In general, Japan and European countries rely on market forces to set prices and, while the DOE or IEA is better equipped to provide specifics regarding product prices and consumption patterns overseas, I suspect that most or all of the oil price increase since the Iraqi invasion has been passed on to consumers just as it was during earlier supply disruptions. In fact, during the 1978-79 oil crisis, consumers in Europe and Japan where free market forces were allowed to function unimpeded to moderate prices and allocate supplies—faced considerably less discomfort than Americans who struggled with shortages and long gas lines as a result of government attempts to manage oil supplies and keep prices artificially low. In my conversations with energy policymakers and analysts in Europe and Japan, I find evidence of continued commitment to market forces during today's tenuous oil supply situation.

In comparing U.S. energy policy with that of other consuming nations, it is important to consider the "big picture". The U.S., by virtue of its rich and diverse indigenous energy resources, is considerably less vulnerable to energy supply disruptions than many other industrial nations. In 1988, almost 20% of the world's primary energy production was in the U.S., compared with 11% for all of Western Europe and less than 1% in Japan. Japan has virtually no domestic oil reserves, while Western Europe has 18 billion barrels (11 billion which are in Norway) and the U.S. has more than 26 billion barrels.

Countries with few energy resources have less energy security than we do in the U.S., and a more activist energy policy may be appropriate in these environments. I believe that while we can learn some useful lessons in examining energy policies in other countries for example, how France and Japan have successfully launched ambitious nuclear power programs since the Chernobyl accident—we should carefully consider our own situation (available energy supplies, fiscal priorities, public sentiment, consumption patterns, technological innovation, economic growth, etc.) before adopting a policy that has proved successful somewhere else.

In comparing the effect of oil supply disruptions and price hikes on foreign economies, we should not forget the Third World which still struggles under a crushing debt burden acquired during previous oil crises. In the past, developing countries really paid twice for spiraling oil prices: through higher import bills for their oil supplies, and reduced demand for their exports that resulted from global recessions fueled by earlier energy emergencies which exacerbated balance of payment problems. Los Alamos and other U.S. national labs have successfully completed some important alternative energy development and energy planning projects in the Third World. More such efforts by the U.S. or IEA to transfer some of our technological "know how" to help develop indigenous energy resources in developing countries (e.g., geothermal, solar, biomass) could make a measurable contribution to limiting Third World vulnerability to energy crises in the future.

Question: Aren't the high energy taxes levied by Japan and Western Europe in effect oil import fees?

Answer: As discussed in the answer to question #3, while oil import fees and energy taxes have similar effects on prices and consumption, oil import fees encourage domestic production while energy taxes do not. Thus, energy taxes act to dampen consumption only. In a country such as Japan—where there is no domestic oil industry—the effect of an energy tax on consumption and imports is identical to an import fee, while in countries such as Norway or the U.K., who have local oil production, the impact of an oil import fee would be different than the impact of a tax. Since there are differences in the two policies (oil import fees and energy taxes) in how they are administered and the effect on consumption and production in many countries, I believe it is less confusing to refer to each distinctly and not attempt to equate them.

Question: How do the effects on the U.S. economy of the oil price bust in the 1980s compare with the effects of the current price increase?

Answer: It is still too early to know what effect current oil price increases will have on the U.S. economy. Our experience with oil price hikes in 1973 (when oil prices tripled from $4 to $12 a barrel) and 1978-79 (when prices skyrocketed from $14 a barrel to well over $30) taught us that a major oil supply disruption can undermine global prosperity, development and security. An oil price increase has a strong effect on the operating costs of many industries including chemicals, airlines and trucking. These costs are passed along to consumers, who must contend with higher costs for home heating fuel and gasoline as well. Higher fuel bills mean less money is available for discretionary spending and personal consumption falls. Corporate profitability and investment declines, unemployment rises and tax revenues drop. Previous energy emergencies had serious economic repercussions and plunged the world into a recession. The chance of a similar response to today's energy situation depends on the extent and duration of higher oil prices.

There is real concern that today's high oil bills will exert further downward pressure on a U.S. economy that some argue is already approaching the early stages of a recession. While I believe the U.S. economy is robust enough to sustain oil prices in the $25-$35 range for quite some time, a dramatic price increase caused by a real or perceptual major supply disruption could have serious consequences at home and abroad. Indicators to watch carefully in the months ahead include economic growth (GNP), inflation, unemployment, balance of payments, corporate profits, and tax revenues.

One fact that deserves mention is the significant progress that has been made in reducing oil consumption and using energy more efficiently since the time of the earlier crises. Since the OPEC embargo in 1973, the U.S. has become a much less energy-intensive society, limiting the overall impact that oil prices can have on our economy. Notable developments include substitution of alternative fuels for oil in generating electricity (since 1970, oil's share of the U.S. utility market has dropped from 11.4% to 5.7%), advances in technology that provided sizable energy-productivity improvements in industry consumption and the transportation sector, and improvements in home construction that dramatically decreased household energy consumption. As a result of these developments, the U.S. uses virtually no more energy (and less oil) today than it did in 1973—although our population is still expanding and the nation continues to turn out more products and services. Without the improvements in energy productivity that have taken place since 1973, the U.S. would require the equivalent of about 14 million more barrels of oil every day. Thus, today's higher oil prices have less impact on our economy than during earlier crises because we are less dependent on oil as a percentage of our total energy use.

Question: Do you support the idea of maintaining a floor price for oil to buffer the negative effects of both swift drops and swift increases in oil prices? What do you think an appropriate level for such a floor should be?

Answer: Under some circumstances I would consider use of a floor price—but only if such action were taken internationally. To unilaterally institute a floor price would harm our competitive trading position vis-a-vis our trading partners—a situation we want to avoid. The level of a floor price, if implemented, should be sufficient to encourage conservation, alternative fuels (especially renewable energy), and increased oil and gas exploration and production. A floor price in the low to mid-$20s may be appropriate to meet these goals. Before firmly committing to the concept of floor price, however, I would like the benefit of comprehensive economic analysis showing the true costs and benefits to the overall economy—comparable to the analysis we prepared in our 1987 study, "Energy Security."

Question. Do you support increasing the CAFE standards for automobiles and light trucks sold in the U.S.? Is there any other action as cost-effective for reducing U.S. oil demand? Is there any option with potential for greater effect in reducing U.S. oil demand?

Answer: Clearly, our dependence on petroleum products for transportation is a key factor affecting our need for imported oil, and successful efforts to reduce this demand could have a measurable impact on our energy security. In 1989, motor fuel consumption accounted for 8.8 million barrels a day—more than half of our daily oil consumption and exceeding the amount of total domestic petroleum production (7.6 mbd in 1989); thus, we are in the rather uncomfortable position of consuming more oil for one purpose alone (transportation) than we are able to produce.

Despite these rather grim statistics, it is important to remember that we have made some impressive progress in fuel efficiency that have served to keep demand for motor fuel lower than it would otherwise be. At the time of the first serious oil emergency in 1973, passenger cars were averaging 13.3 miles per gallon. Since then our fuel rate has steadily improved in the U.S., surpassing the 20 mpg mark in 1988. Fuel consumption per car dropped from 771 gallons in 1973 to 507 gallons in 1988. However, the total number of passenger miles increased during the 1973-88 time period, pushing up aggregate motor fuel consumption by more than 15%. Thus, the imperative to reduce demand for transportation fuel over the long run remains.

There are two main ways to reduce motor fuel consumption—increase CAFE standards and develop alternative fuels—both with associated costs and benefits. I have stated before this Committee in the past that I thought CAFE standards served a useful purpose in encouraging greater energy efficiency at a time when oil prices were controlled. Alternative fuels offer some intriguing potential for displacing our need for transportation fuels, particularly if we are willing to take a long-term perspective and aim to for successful commercialization by the year 2000 or 2005. I am particularly impressed with the potential that fuel cell systems (which would be used to power electric vehicles) offer for transportation applications, which I understand could be viably demonstrated within 5 or 10 years. Fuel cells can operate on alternative fuels (methanol) and are more efficient and cleaner burning than combustion engines. While impediments to commercial applications remain, progress is being made and it appears that timely application is possible for larger vehicles such as city buses. Other alternatives that offer potential in the transportation area include methanol transport fuel, coal gasification technology, natural gas conversion, liquefied petroleum gas and compressed natural gas.

The large barrier to commercialization of alternative fuels is development costs and, at least initially, the limited marketability (based on relatively high prices and gasoline's entrenchment in the market place), which may imply that the viability of alternatives is dependent, in part, on government sponsorship. One way that government could give alternatives a push in a cost-effective manner would be to provide funding for applied research—for example converting methane to methanol which currently is problematic and is hindering its use as a transportation fuel, or funding the critical move of technology from the research lab to the marketplace. These decisions, which should be made within the context of a cost-benefit analysis of these fuels' pros and cons relative to gasoline, could be incorporated into the debate over National Energy Strategy that will probably accompany DOE's report to the President latter this year and the President's recommendations to the Congress in Spring 1991.

In order to judge what is the most cost-effective, viable and timely strategy to displace some U.S. demand for petroleum transportation fuels either through more stringent CAFE standards or greater use of alternative fuels, I would like to see a study incorporating the costs and benefits associated with both strategies. In addition to the energy security benefits from reducing demand for oil, progress in this area would most probably result in environmental benefits as well.

Question: Are there sensible steps we could take to encourage the replacement of oil-burning power plants, which still are quite common on the East and West coasts? What are they?

Answer: One of the major developments that has benefited our energy security in the last 15 years is the displacement of oil as fuel for electricity-generating power plants. At the time of the oil embargo in 1973, oil accounted for 17.7% of electric utilities fuel consumption; by 1989 this share had dropped to only 6.4%. As a result of this sizable effort by utilities to limit their dependence on a relatively insecure fuel source, the amount of petroleum consumed by utilities dropped from 563 million barrels in 1973 to 270 million barrels last year, despite a 49% increase in the amount of electricity generated over this period. If utilities had maintained the fuel use patterns that were in place in 1973, they would require approximately 475 million more barrels of oil a year to meet their fuel requirements roughly equal to 60 days of U.S. oil imports.

Despite this rather remarkable progress, it is no time to rest on our laurels. Oil was displaced from utilities' consumption largely by building more nuclear powered- and coal-fired plants. With public opposition to nuclear power all but eliminating this option today, and coal burning increasingly under attack because of environmental concerns, now is the time to consider how we can meet our growing needs for electricity, as well as replace power plants that reach the end of their useful lives. Otherwise it was quite possible that utilities will return to oil as a energy source.

One option is greater use of natural gas. Natural gas, which is environmentally superior to either coal- or oil-burning, is the energy source for 9.4% of electricity generated in the U.S. today—this share could be expanded significantly. Our own analysis in our report, "Natural Gas: A Strategic Resource for the Future," projected that utility consumption of natural gas would double by the year 2010 to provide nearly one-sixth of the primary energy used in generating electricity. This expanded usage would require about 6 trillion cubic feet of gas annually, or more than twice as much as is being used now by the electricity industry.

A second way to limit our need for oil to generate electricity is to continue to promote the development of clean coal technology. Coal, which currently fuels approximately 60% of the electricity generated in the U.S., is the "work horse" of our utility sector, all but assuring its role in the U.S. energy mix for years to come. Clean coal technology offers the potential to use this relatively cheap, secure and abundant energy resource in an environmentally-sensitive manner.

We may also wish to re-evaluate nuclear power and make the regulatory changes and technological investment that would make it a more viable choice for utilities. Public opposition remains a serious problem that will need to be dealt with for nuclear power to re-emerge as a viable option.

Finally, alternative energy offers some promising potential for meeting our growing needs for electricity in a way that is consistent with our environmental goals. Integrated Gasification Combined Cycle technology and fuel cells are projected to be economically feasible in the next 15 years and their favorable environmental characteristics make them potential candidates for widespread implementation. Geothermal, solar photovoltaics and wind power generation technology have more limited potential, but could still contribute to economically-feasible and secure power generation by the turn of the century. Furthermore, the U.S. has demonstrated leadership in all of these technological areas, and is well-poised to enhance global energy security in the years ahead by successfully developing and commercializing alternative energy sources. Cooperative research—both internationally and between our National Labs, universities and the private sector—may be an appropriate venue to pursue emerging technologies in a cost-effective manner.

Future debate on the role of alternatives in displacing fossil fuels in electricity generation should take place within the framework of market principles and a long-term perspective on national strategic issues and include appropriate performance criteria: relative prices and commercial feasibility, regulatory practices, environmental goals and public acceptance. U.S. energy demand is expected to grow by more than 5 quadrillion Btus by the year 2000. Careful planning by the utility sector and government policymakers can help assure that we harness our technological prowess to meet this need in an environmentally acceptable, cost-effective manner.

Question: Are there steps we could take to encourage the replacement of oil as a heating fuel, either through substitution or increased efficiency? What are they?

Answer: Heating homes and water currently accounts for 72% of all residential energy consumption and approximately 9% of total U.S. energy consumption. The oil crises in the 1970s spurred development in conservation technologies and improved building design which resulted in greater efficiencies in the use of heating oil. Although there is still room for improvement, there is a consensus among energy experts and engineers that the most easily implemented, cost-competitive and significant conservation improvements have already been made, and that further progress will be more expensive and yield only marginal guns. Thus, a strategy to provide secure, cost-competitive sources of heating fuel and, more specifically, limit the use of oil for this purpose, should address alternative energy sources as well as conservation.

One option is to substitute natural gas for oil. Gas is already supplying heat to more than 56 million of the nation's 88 million homes. Electricity—generated by non-oil-burning power plants—could also be used as a substitute for heating oil. The viability of these options is ultimately determined by consumer preferences that are driven, in large part, by cost concerns. If these or other alternatives are readily available, cost-competitive and efficient, new home construction will increasingly incorporate natural gas or electrical heating systems.

Over the next ten years, emerging energy sources offer some promising potential for heating applications. One exciting possibility is to tap the vast supply of heat beneath the earth's surface to provide space and water heating. Although geothermal reservoirs in which ground water carries heat close to the surface can be useful, they are rare. Deeper down in the earth, however, there is a vast storage of rock that is hot but dry (called hot dry rock), a non-polluting and virtually inexhaustible source of energy particularly well-suited for heat applications. In 1977 the world's first hot dry rock energy system, which included participants from the U.S. National Labs (Los Alamos), Japan and Germany, produced water that could have heated several hundred homes. Recent studies have indicated that hot dry rock could be competitive within five years, and further collaboration could advance the development of commercial hot dry rock energy technology. Another alternative to heating oil that could become cost competitive and commercially viable in certain geographic locations over the next decade is solar thermal technology, particularly if product unreliability concerns—currently hampering public acceptance—can be overcome.

Question: Have the increases in oil prices been reflected in similar increases in other energy prices? What has suppressed increases in other energy prices? If our inability to substitute other energy sources easily for oil is a major factor in the price volatility of oil, shouldn't we be giving greater emphasis to research and development of long-term substitutes for oil, such as alternative motor fuels; finding ways to get people to switch from oil heat; and finding ways to get utilities to replace oil-fired power plants? Do you have an specific suggestions as to how best to pursue such ends?

Answer: Prices of non-oil energy sources have generally not increased in the face of the sky-rocketing oil prices we have experienced since the Iraqi invasion of Kuwait, nor do I expect them to rise unless the current tenuous energy supply situation is, or is perceived to be, a permanent state of affairs. Although oil, natural gas, coal, renewables, etc. are to some extent interchangeable, in many cases large capital expenditures, long-lead times and sometimes technological innovations and/or a shifts in public tastes or expectations are necessary for consumers to switch from one energy source to another. However, in the medium- to long-term, economic models of supply and demand will hold true for energy markets, and sustained high prices for oil will result in increased demand for, and availability of, substitutes.

The current supply problem is still perceived as temporary as demonstrated by our domestic oil industry's reluctance to embark on new exploration despite record-high prices; a more long-lasting supply disruption caused, for example, by damage to Saudi oil fields, would increase the likelihood of new exploration and enhance the commercialization of substitute energy sources. We have learned from past energy emergencies that, when left unimpeded, the market place will eventually bring energy supply and demand into equilibrium through price changes, modification of consumption patterns and shifts in investment spending. Efforts to modify or speed up the processes have, in the past, led to inefficiencies and shortages—an outcome to be avoided.

This is not to say that there is not a role for energy policy, particularly in the energy security aspects that are for the focus of this question. One of the problems associated with relying on markets is the short-term perspective that typically prevails. There is debate on what constitutes a fair price of energy, with some arguing that oil has not been adequately priced to reflect all costs (including environmental and defense costs) associated with its use. Certainly oil prices over the past few years have not reflected long-term supply conditions: at a time when prices dropped to historic lows, world oil production reached 85% capacity—a level which, in the past, has led to heightened vulnerability to supply disruptions. Thus, at a time when our energy security was deteriorating, oil consumption was rising, not declining. While our energy situation is considerably more secure today as a result of government policies including conservation programs, energy research and building our strategic stock pile of oil, cheap, plentiful oil since 1986 has led to some complacency and progress in energy conservation and diversification has slowed. Now is time to take stock of the long-term energy situation and reassess our security needs.

In my testimony, I noted several policies that could be pursued to reduce our oil dependence, mindful of economic realities and environmental goals, including development of clean coal technology, revitalizing the nuclear option, allowing oil and gas exploration on federal lands and off-shore in an environmentally-sensitive manner and consideration of an internationally-set floor price for oil. These policies are mindful of Senator Ford's comment during the hearing: "Can we do something which does not increase the deficit?" We should also focus the vast scientific and technological resources in our National Laboratories on developing efficient, competitive alternative energy sources—an idea that may be particularly timely given the reduced need for weapons-related research.

The Senate Energy Committee has always been a vocal proponent of energy security (even during times of seeming abundance)—a sentiment that George Bush often expressed when I worked with him in the 1988 Presidential campaign. With public attention focused on this issue, now is the time to move forward with creative strategies to assure our energy security for decades to come.

Question: Since natural gas is the fuel most easily substituted for oil at this point, shouldn't we have a policy of protecting our natural gas supplies? In light of the potential for natural gas to displace oil, do you believe that the recent DOE decision to license a project to export Alaska North Slop natural gas to the Pacific Rim is in the best interest of the United States?

Answer: Natural gas is a clean and valuable substitute for oil which has a major role to play in our energy future. Our own projections suggest that natural gas use can increase by one-third over the next twenty years—primarily in electricity generation. We can count on increases in domestic production, imports from Canada and, over the longer term, gas from Alaska to satisfy natural gas demand well into the next century. I would like to submit for the record a study we prepared two years ago entitled "Natural Gas: Strategic Resource for the Future" (attached) supporting these conclusions.

Over the course of the last decade, we have seen growing deregulation of the natural gas industry—from gas prices to gas pipelines. While any effort to deregulate causes some inconvenience, I would say that on the whole the free market direction taken by the Reagan and Bush Administrations and FERC has been appropriate. At the moment, however, there are complaints about delays in approving new pipeline systems. The issue needs to be addressed now only from the point of view of how approvals can be expedited, but from a broader perspective as well; for example, by addressing the basic question: How can the functions of FERC be streamlined and modernized based on developments of the past ten years.

It is important to note, however, that natural gas is not a panacea to our long-term energy supply problems. As our projections show, we will still need to increase both coal and nuclear power by one-third if we are to satisfy even modest rates of electrical growth over the next twenty years.

I am not familiar with the DOE's recent decision involving gas exports, but as a general principle I prefer a free and open trade system—like the Free Trade Agreement with Canada—which allows resources to flow freely and efficiently to their most appropriate market.

Question: How can the United States and U.S. companies best take advantage of the potential of the Soviet Union to increase its oil production?

Answer: There is no doubt that the Soviet Union's oil industry could benefit from U.S. technological and managerial "knowhow". While the USSR still produces more oil than an other country on earth, and has the largest proven reserves outside of the Persian Gulf (58 billion barrels), inferior engineering techniques that emphasized quick production, bad management, out-of-date technology and a shortage of capital has seriously hampered Soviet oil production and experts predict that very soon the country will become a net importer of oil. Currently the Soviets are extracting approximately 20% of recoverable reserves; experts estimate that with U.S. technology and recovery techniques, extraction capacity could be more than doubled to recover 50% of reserves. Hard currency earnings from oil are critical to the Soviets, and Mikhail Gorbachev is actively courting U.S. technology and investment to upgrade Soviet oil production facilities.

U.S. oil producers, refiners and oil service companies are already actively involved in assessing the market potential in the Soviet Union. Chevron has moved forward with a joint venture where, in return for oil, they will explore and help develop the Caspian Basin region, and Dresser Industries has just signed an agreement to help modernize the Soviet oil equipment industry. Texaco and other producers are also considering exploration ventures and I, a geophysical surveying company, has launched an ambitious marketing campaign in the USSR.

Despite the recent receptivity to foreign investment expressed by the Soviet leadership, there are still many impediments to setting up profitable energy ventures in the USSR including basic unfamiliarity with market principles, an unskilled labor force incapable of efficiently operating sophisticated exploration and production equipment, limitations on repatriation of profits, inconvertibility of the ruble, etc. There is also significant political risk associated with long-term energy business relationships with the Soviet Union stemming from domestic unrest, labor disputes, the possibility of future economic sanctions prohibiting U.S. imports of Soviet goods, and the USSR's past track record of using energy as a political weapon, as demonstrated last year during the Lithuanian drive for independence. In my conversations with oil executives, I find that concerns over the ramifications of these types of political issues has contributed to the reluctance to launch business ventures with the Soviets.

With regard to the role of the government in encouraging U.S. involvement in Soviet oil production, the overriding factor is whether this activity is in the best interests of the U.S. The benefits are increased export earnings and enhanced global oil production, with reduced dependence on the volatile Middle East. Boosting Soviet oil production would also help Gorbachev pursue his economic policies, and perhaps help ensure his longevity—a goal that many feel is consistent with U.S. interests. In light of these benefits, both the U.S. Department of Commerce and Department of Energy have initiated their own programs to help U.S. oil business develop market opportunities in the USSR.

On the other hand, transferring U.S. technology to the Soviets presents some security challenges that must be considered very carefully. For example, some seismic technology used for identifying oil deposits can be used in anti-submarine warfare and is currently restricted from export to the USSR. The recent thaw in East-West tensions has resulted in relaxing COCOM regulations somewhat, while continuing progress is being made in modifying the list of restricted technology still further—changes that may prove beneficial to U.S. oil businesses interested in exporting to the Soviet market.

Policymakers need to balance our economic and diplomatic goals with long-term U.S. security interests in developing export, federal investment and insurance policies that provide a favorable business environment that does not compromise vital national security interests or pass along the "cost of doing business" (through defaulted government loans or insurance losses and/or increasing our need for defense research to counter technology losses) to the American taxpayer.

Question: Do you believe the President should be given additional authority to institute energy oil allocations? What sort of additional authority would you advocate?

Answer: I do not believe that the President should be given greater authority for energy oil allocations. We are very fortunate to have a 600-million barrel strategic stockpile of oil which can help soften the impact of oil disruptions. I would hope that the President would encourage market supply and price stability during times of supply disruptions through market mechanisms coupled with coordinated drawdown of IEA member country stockpiles.

RESPONSES TO QUESTIONS FROM SENATOR BINGAMAN

Question: If the U.S. decided as a matter of national energy policy to displace oil with other fuels where possible, how long would this transition take? What factors would dictate the pace of this transition? What would be the costs associated with this transition?

Answer: Oil use in our energy economy has been reduced significantly since the early 1970s as substitutes for oil have been used increasingly used in electrical generation. Today, the major sectors where oil is needed extensively is in transportation and home heating. Reducing our current consumption of oil (we use approximately 16 million barrels of oil per day) in a significant way would require major progress in reducing our demand for transportation oil—currently we consume more oil in our cars than we produce in the U.S. As I outlined in a previous response, alternative fuels and fuel cells to power electric vehicles offer some exciting potential for displacing our demand for transportation fuels if we are willing to adopt a long-term perspective. In addition to the time needed to successfully commercialize these emerging technologies, however (including bringing the cost of production down to allow for competitive-pricing), auto fleets in the U.S. turn over only once a decade. Therefore, even if alternative fuels become available in the mid- to late-1990s we could not expect to displace much more than 5% of demand for oil for transportation purposes by the turn of the century. This figure could grow significantly by 2015, however; for example, the availability of 25 million alternative-fuel vehicles could displace approximately 15% of demand for oil-based transportation fuels (for a savings of about 2 million barrels of oil each day).

Thus, the transition away from oil in the U.S. economy hinges on reducing demand for oil for transportation, and realistically significant progress is probably a decade away. That does not mean that we should not make efforts to bring these new technologies into effect, however. Increased industry-government collaboration similar to the Oil Recovery Technology Partnership forged between the Department of Energy, Los Alamos and Sandia National Laboratories and the petroleum industry focusing on cutting-edge research in engineering technology could encourage timely, cost-effective research, as could international collaboration between government and university research groups. Perhaps we could consider an international strategy, to be announced at next year's Heads of State Economic Summit in London, where the world's leading energy consumers could endorse a major new initiative to make research into non-oil autos a priority objective.

Question: In formulating a national energy policy for the United States, what can be learned from the energy policy experience of other developed countries? To what extent do political, cultural and economic differences between the U.S. and other countries affect the relevance of other countries/energy policy experiences for purposes of formulating U.S. energy policy? To what extent should U.S. energy policy be coordinated with the energy policies of our allies?

Answer: The record of energy policy in other nations is as mixed as our own. Perhaps the most valuable lessons from aboard is that discipline, long range planning and consistent government signals are the three principles of successful programs. The French and Japanese stand out as very successful in this regard. The U.S., with its rich and diverse base of energy resources, has many alternative energy options to choose from—a situation that, combined with conflicting interests and a relatively low sense of urgency, has led to near-paralysis in the energy policy arena. France and Japan, countries with a much smaller energy resource base than we have in the U.S., do not have that luxury of adopting a laissez-faire approach to energy and, for reasons of national security, have had to be very aggressive in developing whatever energy sources they had at hand. This is not to say that energy policy formation is easy anywhere, but rather that energy policy is strongly influenced by country-specific characteristics including indigenous resources, public attitudes, environmental regulations, economic activity, etc.

With world-wide oil supplies so tenuous, all nations are struggling to satisfy energy demand and that it why it is so valuable to monitor carefully the activities of the International Energy Agency—an agency which has had the support of the U.S. Congress since its inception in 1974. The best preparation I had for taking on the job of Deputy Secretary of Energy was my four years at the IEA comparing and analyzing different energy policy approaches among the 21 members. One clear lesson of the IEA is that it is essential that member countries policies be coordinated—though this is not to say that they have to be the same. A clean-coal power project in Italy, a nuclear power plant in France, enhanced oil production in the U.S.—all contribute to ensuring adequate energy supplies around the world. Cultural, economic and resource characteristics vary from country to country and may affect the appropriateness of specific energy policies in individual countries, but one goal is paramount: to lessen oil dependency on our common vulnerability—the Persian Gulf.

Question: Even if the U.S. could achieve greater security of supply by shifting its sources of imported oil, wouldn't we still be vulnerable to price swings due to the interdependence of world oil supplies?

Answer: Yes. There is no such thing as an isolated energy market. Although diversifying oil imports can help protect us from politically-inspired oil supply disruptions like that which occurred during the Arab/Israeli conflict in 1973, prices everywhere rise in response to a significant shortage anywhere in the world. Diversification bolsters our energy security by reducing the chances of a major energy disruption, but does not offer any protection from the oil price shocks that inevitably accompany a significant or sudden drop in global oil production.

Question: What can be done to check "artificial" demand for oil caused by the inclination to build stocks and "top off the tank" in response to market uncertainties?

Answer: I favor a coordinated response among the IEA nations to avoid "abnormal price bidding," as well as action in times of disruption to coordinate stock policies. I believe that the IEA is playing such a role at this time. Public information campaigns may also have a limited role to play in reducing demand pressure during times of impending energy shortages.

Question: The past two months have demonstrated the linkage between the futures market, the spot market, wholesale contract markets and retail prices for refined products. We have also witnessed great price volatility. Is this situation where prices appear to bear no relation to supply and demand fundamentals beneficial to the nation's economy or in terms of energy policy?

Answer: Prices are partly influenced by a small supply crude shortfall (about 600,000 b/d). The major impact on prices appears to be the political-military situation in the Gulf. Based strictly on supply and demand conditions, prices today would probably be about $22-$24—the "premium" paid above that is due to expectations of future shortages. This is likely to be the driving concern in the market for the next few months, although prices appear to have stabilized as consumers consume less and become somewhat acclimated to the ongoing Gulf situation. Escalating hostilities, particularly those threatening Gulf oil fields or production and transportation facilities, could send prices spiralling upwards, however.

Of course increases in energy prices are detrimental to our economy—they fuel inflation, reduce corporate profitability (and tax receipts) and personal discretionary income, and eventually lead to higher unemployment. We have learned in the past however, that attempts to soften the blow by manipulating energy prices and supplies only exacerbates the problem and should be avoided at all costs. A better strategy is to focus on developing a secure long-term energy future, where economic costs associated with high-priced energy are kept to a minimum.

Question: Seventy-seven percent of the world's crude oil reserves are held by OPEC nations and 63 percent of the world's reserves are located surrounding the Persian Gulf. In the first half of 1990, the OPEC nations accounted for 51% of non-Communist oil production and 39% of total world oil production. Given this concentration of both reserves and production, is free trade in the oil market really possible? If not, how should this affect the formulation of U.S. energy policy?

Answer: Obviously we recognize that the best government policies are those that rely on the market. We argued this strongly during the Reagan years and now into the Bush Administration. Once I was asked by a Cabinet member in the Reagan years, Why is oil different from steel? and my answer was that seventy-five percent of the world's steel does not come from the volatile Persian Gulf. Yes, oil is different because of the concentration of it in the hands of a few and the critical importance it has in our economy. We should be mindful of this and be willing to pay a price for energy security. The problem becomes getting anybody to pay a price for security when they can benefit in the short run from a cheap commodity. Nobody cared to listen when the Senate Energy Committee and others warned about problems of energy security when we had extensive hearings in 1987-88. We must use the present situation in the Gulf to remind our publics, as well as others in Congress and the Administration that now is the time to pursue cost-effective policies which will provide long term national security and economic benefits to the United States . . . and yes, it might take a bit of a sacrifice to achieve that long run security.

Question: What can be done to promote energy efficiency and conservation? What can be done to ensure that energy efficiency gains and conservation achieved in response to high oil prices are not lost once oil prices return to lower levels? Can energy efficiency be "enforced" or must we rely wholly on market forces and voluntary choices made by consumers?

Answer: I believe that consumers and industries are mindful of energy efficiency. The fact is that we don't use any more energy today than we did in 1973—despite significant economic growth during that period—demonstrates that fact. Conservation gains, in my view, should be stimulated primarily by the market, not by government policies. This is not to say that we should not encourage a tax credit for energy efficiency, along with tax incentives which may be granted for conservation or alternative energy research. We should also considering funding promising conservation technologies, perhaps in partnership with major industries—like we do in DOE's cost-sharing program with industry to develop clean coal technology.

In conclusion, let me say that I look forward to DOE's National Energy Policy and applaud them for taking the debate to the grassroots. I would hope that each of the options identified would be analyzed from three major perspective: environmental impact, degree to which it lessens oil dependency and finally cost/benefit to the total economy. Energy policy should not be viewed in isolation from other national priorities; rather it should be viewed as an integral part of our long term national competitiveness and national security.

CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES,
Washington, DC, October 15, 1990.

Hon. J. BENNETT JOHNSTON,
Hart Senate Office Building, Washington DC.

DEAR SENATOR JOHNSTON: I have received your letter of October 9, forwarding an extensive list of follow-up questions posed by Senators Wirth and Bingaman. Although I strongly support a full array of domestic energy options on both the supply and demand sides, my testimony focused upon the urgent need to develop additional oil export capacity outside the Middle East, so I will limit this response to questions related thereto. I would also emphasize that these replies—like my October 2 testimony—reflect my personal opinions rather than any views of CSIS.

The following questions appear to me to relate to the thrust of my testimony:

Senator Wirth: "What would the effect of an oil import fee of $5 per barrel be on energy consumption and energy production in the U.S.? Do you think that such a fee is a good idea, and why do you have that opinion?"

Senator Wirth: "Are there sensible steps we could take to encourage the replacement of oil-burning power plants, which still are quite common on the east and west coasts? What are they?"

Senator Bingaman: "Even if the United States could achieve greater security of supply by shifting its sources of imported oil, wouldn't we still be vulnerable to price swings due to the interdependence of world oil markets?"

Senator Bingaman: "How as part of a national energy policy can the federal government mandate or at least strongly encourage that oil companies, refineries and purchasers of refined products diversify their sources of imported oil and refined products?"

In weaving together answers to those questions, I would note than an expansion of oil export capacity outside the Middle East—especially the vast potential in the Western Hemisphere offers the United States three interactive but somewhat separate benefits:

> Diversification of political control—Since the threats to Middle Eastern oil derive from tensions reflecting vastly different governance, politics, culture, religion and heritage, we can certainly ease those tensions by relying upon countries where those differences are much less pronounced.
>
> Physical proximity—it is obviously easier and cheaper to provide military protection for sea lanes and facilities in the Western Hemisphere than in the Persian Gulf.
>
> Supply proliferation—while Senator Bingaman correctly observes that the interdependence of world oil markets makes imports from any source—or from the United States for that matter—vulnerable to price shocks, history demonstrates that the vulnerability is vastly reduced where there is an abundance of excess producing capacity.

Having identified the advantages of developing additional Western Hemisphere potential, I would reiterate my own conviction that Venezuela's 1.2 trillion—yes trillion!—barrels of heavy bitumen offers an astonishingly huge prospect. It can be utilized in several ways:

Boiler fuel—as Senator Wirth implies, petroleum is so uniquely suited to transportation fuels that it must be desirable to limit its stationary consumption, especially for power generation. The enclosed clipping from today's New York Times reports that Venezuela's bitumen, when combined with water and an emulsifier creates a sort of "liquid coal" called "Orimulsion", that is easily handled, competitively priced and readily cleaned of sulfur. Its use could supplement domestic natural gas, coal and nuclear power in reducing demand for fuel oil.

Transportation fuel—at such times as it becomes realistic to project steady conventional oil prices in the $25-30 per barrel range, Venezuela believes it will be possible to convert bitumen into light production for transportation use. The enclosed brochure provides information on one of the processes, HDH, for achieving that deep conversion.

Senator Bingaman asks (perhaps somewhat skeptically) how the United States government can mandate—or even just encourage diversification of oil imports. I share his apparent skepticism about the degree to which it would be appropriate or practical for our government to actively manage international trade; however, I hasten to add that the government should be equally careful to avoid discouraging diversification.

And yet, the prospect of such discouragement is inherent in the $5 per barrel oil import fee to which Senator Wirth refers. It will be impossible to develop a consensus projection of future world oil prices—or even alternative scenarios—before we have better indications of how the U.S. and Middle Eastern countries will emerge from the current military/political crisis. Despite that uncertainty—and the resulting inability to quantify the impact of an oil import fee—it is possible to identify several general impacts:

Low cost production bias—since higher cost producers have less margin for absorbing the intended adverse impact of an oil import fee, the incredibly low cost producers of the Middle East would enjoy a tremendous cost advantage under an oil import fee. As a result, an oil import fee would tend to discourage investment in higher cost "synthetic oil" from Western Hemisphere sources such as Canadian tar sands and Venezuelan bitumen deposits.

Discriminatory application—the U.S. free trade agreements signed with Canada and under negotiation with Mexico would presumably relieve part of that low cost bias by exempting their exports from a future oil import fee, but this would put the Western Hemisphere's largest reserves—Venezuela's 125 billion barrels of proved and probable conventional oil and 1.3 trillion barrels of bitumen—at a very significant disadvantage.

Political polarization—even the threat of a discriminatory oil import fee inhibits investment in additional Venezuelan capacity and revives unhappy memories of the confrontational U.S.-Venezuelan relationship of the 1950s and 1960s. At a time when some see OPEC splintering into Arab and non-Arab blocs, we would do well to remember that the Mandatory Oil Import Program of that era triggered exporter solidarity and the very formation of OPEC!

Thank you for the opportunity to testify and to provide these further clarifications. I hope they prove useful and would be pleased to discuss the subject in the future.

Sincerely,

G. HENRY M. SCHULER.

APPENDIX II

Additional Material Submitted for the Record

STEVE COWPER
GOVERNOR

STATE OF ALASKA
OFFICE OF THE GOVERNOR
WASHINGTON, D.C.

October 2, 1990

The Honorable J. Bennett Johnston
Chairman
Senate Committee on Energy
and Natural Resources
364 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Mr. Chairman:

On behalf of the State of Alaska, I request that you include recent testimony given by Governor Cowper and by James Eason, the State's Director of Oil and Gas, in the record of your Committee's October 2, 1990 hearing on the nation's energy policy.

The testimony of Governor Cowper and Mr. Eason was presented at a National Energy Strategy Hearing held by the Departments of Energy and Interior in Fairbanks, Alaska on August 27, 1990. Copies of their testimony are enclosed herewith.

Thank you for your consideration of this material.

Sincerely,

John W. Katz

John W. Katz
Director of State/Federal Relations
and Special Counsel to Governor

Enclosures

cc: Governor Steve Cowper
Jim Eason
Senator Ted Stevens
Senator Frank Murkowski
Congressman Don Young

HALL of the STATES — Suite 518 — 444 North Capitol Street N.W. — (202) 624-5858

Presentation by

Governor Steve Cowper

State of Alaska

For the

Alaska Regional

National Energy Strategy Hearing

Fairbanks, Alaska

August 27, 1990

The importance of energy, in particular oil and gas, production to Alaska is self-evident to those of us who live here, especially to those who can remember the days before the first discovery well was drilled at Prudhoe Bay. However, the contributions which Alaska's oil production makes to the national economy and to national security are perhaps not as well known to many of our fellow citizens in the lower 48 states. As the events of early August and the ensuing weeks have clearly demonstrated, we cannot afford to think of a National Energy Strategy as being a short term fix for the "crisis of the moment". No matter what the crisis -- whether an environmental disaster or escalating oil prices -- our energy strategy is sure to fail if it merely becomes an expedient patchwork of responses. The National Energy Strategy must be a well-crafted and comprehensive plan which forms an essential part of our nation's future policy.

There are some very basic elements which, in my opinion, are essential to any effective energy policy. First, regardless of the range of components in a national energy strategy, oil and gas leasing and development in Alaska is, and will remain, extremely important to both the state and the nation. For reasons which I will elaborate on momentarily, this is an inescapable conclusion.

Second, the timely exploration and development of the coastal plain of the Arctic National Wildlife Refuge (ANWR), the most prospective unexplored onshore petroleum province remaining in North America, must be an integral part of the nation's energy policy if our goal is to strengthen domestic production and reduce foreign oil imports.

Third, continuing debate over environmentally-related mitigation of oil field development and production in Alaska must be considered at the highest policy levels--in both state and federal government--and reconciled. The possible impacts of not coming to closure on these debates range from significant increases in production costs to the complete exclusion of certain new development projects. These effects will be amplified as current production declines.

Fourth, an effective national energy plan must logically consider all our future energy options. This plan must provide a road map for achieving our goals, and procedures to establish longterm continuity and adherence to the steps we decide to take. At the same time, however, the plan should remain flexible enough for us to take advantage of new technologies or changing circumstances. Further, we as individuals, need the intestinal fortitude to adhere to all the components of a new energy strategy.

The worthy goals of conservation, greater fuel efficiency, alternative fuel and enhanced recovery research, as well as orderly domestic exploration and development must not be abandoned simply as a reaction to changing and unpredictable world conditions. It is my opinion that early exploration to assess ANWR's petroleum potential is critical to both the State of Alaska and the nation. It may come as a surprise to some of you to hear that the Trans-Alaska Pipeline System (TAPS) has already transported over 7.1 billion barrels of oil from the North Slope, about 6.5 billion of which have been from the Prudhoe Bay field alone. This means that nearly 60 percent of the total proven 11 billion barrels of recoverable oil at Prudhoe Bay have been produced in the 13 years since production began. In fact, North America's largest field, which since 1977 has contributed a major share to this country's daily production, has begun an irreversible production decline which could continue at the rate of 8 - 12 percent per year, even in the face of new investments in secondary and tertiary recovery to coax oil from its reservoirs.

Parenthetically, and to underscore the gravity of this fact, in similar testimony before the House Subcommittee on Water and Power Resources in June 1987--just three years ago--the State's Director of Oil and Gas noted that the five billionth barrel of Prudhoe Bay oil had recently been produced. While the debates on the merits of exploring ANWR continue, the reality of declining North Slope production and its impact on domestic energy production options cannot, and should not, be avoided. Unless the opportunity for making significant new discoveries is made available, production on the North Slope will decline each and every year.

The United States imported a record 49.9 percent of its oil in the first half of 1990. Domestic production was down 5.9 percent from a year earlier, to 7.63 million barrels per day. By June, the last month of the first half, production was down to 7.07 million barrels per day, 7.3 percent below the level of a year ago. With this decline in domestic production, America's oil imports rose more than 7 percent in the first six months over the corresponding period last year, to 8.4 million barrels per day. Without question, the United States, already the world's largest oil importer, is relying more and more on overseas supplies. It is clear to those of us in Alaska that the high oil and gas potential of ANWR's coastal plain, and its potential to reduce the projected domestic production decline, justify an early and thorough assessment of the area's potential.

Alaska has witnessed some extraordinary exploration successes over the years. However, the fact is that the number of failures-- dry holes--both onshore and offshore, far exceeds the successes. These failures serve to emphasize two very important points.

First, having systematically explored and eliminated many formerly promising areas, there simply are no unexplored areas left in this country with ANWR's potential to substantially and positively affect our nation's overall domestic production and balance of trade. Second, we cannot simply assume that ANWR holds oil and gas reserves which can be banked for future development. Our pre-drilling estimates of resources in ANWR may, in fact, be seriously in error, as they were in the National Petroleum Reserve -Alaska (NPRA) and at the Mukluk prospect in the Beaufort Sea. Common sense, as well as national security and economic efficiency argue strongly for an early confirmation of ANWR's potential. New production from ANWR and other North Slope fields could complement each other to keep TAPS tariffs lower and wellhead prices higher, thus spurring additional exploration in the area.

Now, I would like to address a sensitive issue which has some very far-reaching implications for the future of oil and gas production from Alaska's arctic regions. In the wake of the EXXON VALDEZ accident, renewed nationwide concern over the protection of our natural environment has emerged. Clearly, the public will continue to demand very close attention to the health of our environment--as they should. And yet, everybody wants abundant, cheap energy for economic growth, prosperity and personal comfort.

A major challenge in the years ahead will be the delicate balancing of energy production and environmental protection, in many ways a balancing of economic vitality and human health. To underscore this point, I would like to discuss a few of the major obstacles to new oil field development specific to Alaska, and highlight the types of hard decisions that will have to be made in our joint efforts to balance continued domestic production and the protection of our environment.

Currently, no less than eight federal and seven state agencies, as well as local government and various interest groups, are involved in the permitting and regulatory efforts aimed at maintaining the safe and environmentally sound extraction of oil and gas in Alaska. These agencies have a wide variety of responsibilities which have resulted from the passage of some fourteen major legislative actions which establish the regulatory framework for drilling and development operations. Their mandates and respective authorities include laws ranging from the Clean Water Act (CWA) to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or "Superfund") authorized in 1980, and the more recent Emergency Planning and Community Right-to-Know Act of 1986.

The process of permitting exploration and development activities--which can take several years in some cases--has created an administrative gauntlet which is time consuming and very costly to the petroleum industry. The industry generally has adjusted to this complex regulatory environment and factored the incremental timing and costs into their business and operations planning. However, two major environmental debates have emerged over the last few years which are delaying responsible development, and which may severely restrict or even stop new development entirely--if they are not resolved soon.

The first of these debates revolves around the loss of wetlands habitats on the North Slope. Wetlands losses on Alaska's North Slope generally occur from the placement of gravel for roads, construction pads and other infrastructure to support oil field operations. Disturbed or melting permafrost can cause severe problems to the integrity of overlying structures. The gravel simply acts as a good insulator to help prevent the permafrost from melting. During the brief summer months virtually the entire area of the North Slope can be characterized as a flat, treeless, wetlands habitat on top of permafrost. The federal government's "no net loss" wetlands policy under consideration, if strictly applied, could effectively stop any additional oil field development. The present North Slope oil and gas infrastructure directly influences about 30,000 acres of disturbed wetlands. That area equates to about .07 percent (seven one-hundreds of one percent), of the roughly 41 million acres of Alaska's northern coastal plain. The impacted area is amazingly small considering it includes the two largest producing fields in North America, Prudhoe Bay and Kuparuk.

Potential oil-rich lands are not the only lands classified as wetlands in Alaska. Approximately 170 million acres total, or double the wetland acreage of the contiguous United States, are affected by national wetlands policy. This issue is so fundamental to community development, oil exploration and development, mining ventures and the establishment of transportation corridors that we in Alaska have made the effort to formulate a consensus position on national wetlands policy.

Clearly, a reasonable balance must be struck between wetlands habitat protection and the value to the nation of exploring and developing new domestic petroleum resources in one of the most prospective and sparsely explored areas remaining in our country. I believe that we can have both a quality environment and continued energy development on the North Slope. I also believe, however, that if we are to achieve that goal, we must resolve the wetlands debate at the highest policy levels, not within the permitting staffs of the state and federal agencies.

The determination of negative effects, if any, from the use of both breached (having bridged openings) and unbreached (continuous) offshore gravel causeways represents another controversial issue that must be resolved, and resolved soon, if we are to develop several large discoveries located offshore of Alaska's North Slope.

Causeways provide for the safe and economic transportation of offshore produced fluids to onshore pump station facilities, and they enable year-round road access to the well sites. However, the use and effects of causeways has become a major point of contention between federal and state resource agencies and the state's lessees. The contentious part of this issue is the differing interpretations of the data which have been collected over the years from the areas of the West Dock and Endicott causeways.

Some resource agencies, including the Environmental Protection Agency (EPA) and the National Marine Fisheries Service (NMFS) maintain that subtle alterations in water salinity, turbidity, and various flow and upwelling patterns may degrade anadromous fish habitat. The industry believes that fish populations have not been affected and that habitat degradation has not been demonstrated.

While the arguments continue, the development of several new fields is being delayed. Presently, the development of two nearshore oil fields, Point McIntyre and Niakuk, with combined recoverable reserves on the order of 350 million barrels of oil, is in question due to unresolved issues directly related to the causeway controversy. This impasse must be broken, but it is clear to me that time is running out for some of the smaller, more costly developments. They simply cannot survive protracted academic arguments over the interpretation of the voluminous data which have been collected.

While the state has not concluded all of its deliberations on the issue of gravel causeways, we have addressed the specific permit requests for the Niakuk and Point McIntyre development projects. The state fully supports these projects and firmly believes that they can go forward in an environmentally safe manner.

Certainly, there have been some trade-offs and problems in our efforts to develop the arctic Alaska petroleum resources. The work must be accomplished in a very harsh, remote and, at the same time, fragile environment. Mistakes have been made, but this is a learning process, an evolution of sorts, where we must figure things out as we proceed. On Alaska's North Slope we are learning all the time, and we have come a long way from the early days of open mud pits and unrestricted tundra travel. The efficient and compact development at the Endicott oil field, the very first arctic offshore production, will set the tone for all future projects. And, we can do even better in the future. I truly believe that improving technologies and increased environmental awareness will enable environmentally sound development to occur.

It is extremely important to Alaska and, I believe, the rest of the nation to demand a balanced resolution of these very emotional environmental issues. We must look objectively at "degrees of environmental protection" or potential degradation, carefully weigh the trade-offs of production and protection, and come to balanced decisions on important development projects. Further, we need to stress the importance of an early resolution of these types of issues.

All North Slope production is, and likely will continue to be, transported through the Trans-Alaska Pipeline System (TAPS), which has a finite physical lifespan. Timing is critical to arctic development projects and, in many cases, delays can serve to defeat the economic feasibility of a given project, and thereby cause its demise. Smaller projects which currently can take advantage of infrastructure developed for the very large fields, and the relatively lower TAPS tariff rate, will likely never again be economic to develop should the major reserves be depleted to the point where it is uneconomic to operate TAPS.

I firmly believe that rational decisions regarding the complex and emotional environmental issues coupled with on-going monitoring activities should enable the nation to exploit its energy resources in an environmentally safe manner that is acceptable to the majority of the public.

Finally, I would like to revisit the National Energy Strategy as a whole. We know that a well-crafted energy policy must consider the full range of options, as well as the consequences of pursuing these options. We must explore increased domestic production, environmental safeguards and trade-offs, alternative fuels, emerging technologies in enhanced oil recovery, and increased fuel efficiency, just to name a few.

In Alaska, the West Sak oil field harbors a tremendous amount of oil in place, but technology must be developed to extract this heavy oil. We have enormous fields of low-sulfur coal, but engineering needs to be explored to mine North Slope reserves from permafrost and to dehydrate some our moist coals. We also have abundant natural gas, which requires the development of markets and transportation facilities to make it economically feasible. In the areas we have geothermal and hydroelectric resources, and programs to promote energy efficient construction and retrofitting. But in addition to simply developing and consuming energy resources, we must apply our energy policies with a rigid logic so that one part of the plan supports -- rather than detracts -- from other parts.

The laws which prohibit the export of Alaska's North Slope crude oil are a part of an existing energy policy which simply does not make any sense. All regions of the Lower 48 (except western states in PADD V) are net importers of crude oil and products, a fact which no energy plan is likely to change. The existing surplus in PADD V has led to lower product prices and wellhead prices than would be the case in the absence of an export ban. These lower prices, while having benefitted the region's consumers in the short run, have also, over time, reduced the incentives to explore and develop additional reserves in the entire region. As a result, the discovery and development of new fields, including those which may lie in ANWR, as well as the development of existing fields which are marginally economic, continues to be retarded.

If we identify a major component of energy security with the development of new or additional domestic capacity, as I believe we certainly should, such a policy is clearly contrary to the national interest. This is especially so because the PADD V region is the country's most prospective area for major new oil discoveries, and has the potential to contribute even greater reserves if the statutory export restrictions which artificially depress crude oil and refined products prices are removed.

Although the legislation ostensibly was designed to promote national security, it actually has had the opposite effect. By restricting the logical markets for crude oil produced in the region, these laws and regulations have had the undesired effect of discouraging additional exploration and development of domestic reserves, while at the same time requiring increased imports and contributing to a worsening of the nation's balance of trade.

The balance of payments to foreign oil owners has now reached approximately $60 billion per year. This represents about one-third of our nation's total trade deficit. In addition, the bargain-priced imported oil has resulted in a downturn in domestic exploration which has been estimated to have cost the nation a loss of some 1.362 million barrels a day of domestic crude production. Further, more than 300,000 jobs were lost in our oil industry, as well as many other service jobs in related industries.

Our nation's role as peacekeeper in the Persian Gulf region also presents some conflicting issues. The National Defense Council, analyzing the period from 1986 to 1988, concluded that the cost of oil-related defense outlays in the Persian Basin came to about $14 billion annually, or roughly $29.50 per barrel. This cost may not appear directly at the pump, however, we all pay it indirectly through our federal taxes. Even more astounding is the fact that our international competitors in Western Europe and Japan, who together account for over 58 percent of all of the oil exported by Middle East producers -- considerably more than the U.S. -- enjoy the benefits of our defense, without significantly underwriting the cost.

It is ironic that we are willing to spend billions of dollars on Middle East defense, and risk the lives of our troops in the name of national security, but are unable to come to grips with a relatively simple issue of trade restriction here at home. I am using the issue of the export ban and its relationship to our balance of payments and Middle East policies simply to illustrate the fact that our National Energy Strategy needs to logically address the inter-relationships of the various components of the plan.

As we look back to review the past 20 years of our nation's energy policy, it becomes clear that this policy was crisis-driven.

The oil embargo in the early 1970s quadrupled the price of oil and we reacted. Again, in 1979 when the Iran-Iraq war resulted in a doubling of oil prices in less than a year, we reacted. We took actions mandating increased automobile efficiency, improved home insulation, reduced electric power consumption, accelerated domestic exploration, and research into alternative fuels -- all worthy goals. By some estimates, energy conservation alone has saved us $150 billion dollars per year since 1973, an amount of money equal to the national debt.

Now, the Persian Gulf crisis has us reeling once again. Here, in Alaska, we are being asked to increase throughput through the Trans Alaska Pipeline System. The nation quite simply has not learned those hard lessons of the 1970s. We have failed to maintain continuity in our energy planning.

No plan will free this country from a significant dependence on imported oil. We have to acknowledge this, but at the same time we must be smart. We cannot simply pay "lip service" to the individual components of a national energy strategy -- we need to attack our problem on all fronts. Energy efficiency, alternative fuel development, orderly and environmentally safe domestic exploration are the types of tools we must employ to attain a greater level of security for the nation's future. But, equally important will be our resolve to make a firm and permanent commitment to these strategies. A hastily implemented, crisis driven plan is not a plan at all-- it is a state of chaos that will benefit nobody.

Conversely, the drafting and adoption of a comprehensive National Energy Strategy which applies our forethought and creativity to all areas of our energy dilemma will be a legacy of which we can all be proud. I firmly believe that Alaska--her people and her resources--will continue to play major role in developing that legacy.

Alaska Regional NES Hearing, August 27, 1990
Panel 4 Discussion: Potential Alaskan Energy Production

Prepared Remarks by
JAMES E. EASON, DIRECTOR
DIVISION OF OIL AND GAS
ALASKA DEPT. OF NATURAL RESOURCES

I would like to thank the Department of Energy for providing the opportunity today to discuss Alaska oil and gas resources. As you know, the state has presented detailed factual data on our known Arctic reserves of oil and gas, as well as our projected undiscovered resources in a number of different forums over the past three or four years. We have explored the ranges of possibilities for future production, timelines for the projected decline of our current production, and various obstacles to efficient exploration and development. We have provided extensive testimony on proposed ANWR opening legislation, on the North Slope export ban, and various environmental issues.

Although the Panel 4 topics today touch on all these issues, I do not believe we have the time necessary to give them the exhaustive treatment that is warranted. Instead, I have provided you with handouts that graphically depict Alaska's North Slope reserve and projected resource base, and illustrate Alaska's contribution to US oil production. These materials should speak for themselves; however, I will be happy to address any specific questions you may have.

I would rather use the time today to focus on just a few of the major issues that, if resolved in a timely manner -- and I stress the word timely, -- can have an immediate positive impact on enhancing North Slope production and deferring the inevitable projected declines.

The State of Alaska is in the enviable position of having an incredibly abundant energy resource base, including crude oil, natural gas and coal. Most folks who know me understand how I feel about estimates (or predictions) of future discoveries and production -- it is a very difficult game, rife with ranges of subjective probabilities, risk factors, complex interdependent variables and large uncertainties. And yet, it is a game we must play simply because, as imperfect as it may be, it is the best planning tool available to us. The many variables and iterative methodologies used to generate the estimates we need are extremely sensitive to small changes in values or in timing. For example, small changes in the per barrel price of oil or operating costs -- in one direction or the other -- can serve either to turn a marginal Arctic field development project on or, on the other hand, a giant new discovery off.

Now, I have neither a time machine nor a crystal ball. But I can assure you of three indisputable facts: 1) our primary reserve base -- the Prudhoe Bay and Kuparuk fields -- is in a state of decline that will accelerate and then flatten at a low level in the years to come; 2) the potential for new discoveries in the Alaskan Arctic is very large; and 3) the timeframe required to explore for and bring major new discoveries on to production in Arctic Alaska is between five and fifteen years.

What lies ahead? The answer to this is that we simply do not know. In one scenario, as you can see in the handout materials, Alaska's 20% contribution to domestic oil production continues to fall off, perhaps leading to the abandonment of TAPS late in the first decade of 2000, because operational costs at that time exceed profitability. In another scenario, contributions of major new discoveries in unexplored areas such as ANWR serve to boost production back up to pre-decline period rates at some point beyond the year 2000. And, of course, all the ranges of possibilities in between need to be considered. Will advances in technology, such as horizontal drilling, downhole steam generators, or more efficient chemical sweeping agents serve to bolster production from the massive shallow oil deposits in West Sak and Ugnu? We simply cannot know the answers to these questions.

In the absence of absolute certainty in the future, what we can do is provide well-reasoned policies which promote long-term continuity and consistency. Those policies must enable us to effectively explore prospective areas, and resolve inevitable permitting conflicts as they arise in a timely manner. Such policies would help to avoid the "crisis-driven" responses of the past which can serve to do harm to both the environment and future domestic production capabilities.

Continued deliberation is a luxury we can ill afford. Although there are many unknowns in Alaska's energy future, there are positive steps which we can take right now to enhance our chances of successfully providing for our future energy needs. We are, in fact, relying on the DOE to make strong recommendations to Congress with regard to the following issues:

1) Open new areas to exploration

Prospective areas, such as ANWR, must be made available for leasing and exploration quickly due to the extremely long lead times necessary to bring new Arctic production on line. Exploration is already on track in many of the sparsely explored areas of Arctic Alaska. For example, exploratory drilling was begun by Shell just last year in the Chukchi Sea, and is proceeding this year. Similarly, continued work in the Beaufort Sea and some of the onshore North Slope lands is on track. However, ANWR, the largest potential source of new reserves for Alaska and the nation, is not on a schedule that will allow it to come to fruition unless new discoveries serve to extend the timeframe of the ultimate shutdown of TAPS. In this case, we are betting all our cards on extending the TAPS lifetime. If these other areas come up dry, we may discover that without an incredibly large find in ANWR, we would not be able to justify the economics of restarting an abandoned pipeline. In addition to lost opportunities for development of potential new discoveries in ANWR, currently uneconomic discoveries such as those at Point Thomson, Hammerhead, Seal Island and others would simply be left in the ground.

2) Federal decision-making must be streamlined

The state's permitting and review procedures adhere to strict timeframes for arriving at a decision. Contentious issues and conflicts can be resolved relatively quickly. Monitoring, research on poorly understood issues and mitigation can be implemented to enable a project to go forward at the same time new data are being gathered. Future reviews of the ongoing status of a project enable fine-tuning if significant problems arise. The federal bureaucracy, however, often seems to me to avoid the decision point in favor of prevailing politics. An administrative gauntlet of institutionalized gridlock enables relatively low level bureaucrats, focused on one small aspect of a complex issue of national importance, to paralyze the decision process. I personally believe the public would be better served if the federal government institutes policies which force adherence to a predictable decision-making timeframe. Issues like causeways and wetlands should be resolved in a timely manner by high level federal officials who are likely to have a broader view of the implications and trade-offs of development and environmental protection. Additionally, consolidation of the various responsibilities of the different agencies under one oversight committee for the specific cases where the development project is energy related, could streamline the overall review process.

3) Incentives for new technologies

To economically recover the cold, shallow, highly viscous oil contained within the West Sak and Ugnu reservoirs will probably require, in part, new enhanced recovery technologies. In Alberta, the Canadian government has provided a joint government/industry venture aimed at producing the extensive tar deposits of that region. In contrast, world economics control the capital investments that the North Slope lessees are able to make in exploring new EOR techniques. However, research funding or incentives for companies to accelerate certain pilot projects could have a very positive effect on future production.

It should be clear that the monumental technical and environmental challenges involved in finding, developing and delivering Arctic petroleum resources to market are poised in an oftentimes tenuous balance with the extremely high capital risks. If the capital risks are driven too high through the inability to resolve difficult issues in a timely and consistent manner, I believe our chances to add significantly to our domestic production will be further compromised, and industry will be forced to go abroad to survive.

We have choices available to us. However, failure to pursue these avenues now will simply lead to further delays which inevitably have the effect of rendering some options uneconomic or impractical.

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Bullets for Panel 4

North Slope Reserves

- There are currently seven producing oil and gas fields in arctic Alaska on the North Slope. *Figure 1: Producing North Slope Oil and Gas Fields (January 1, 1990).*

- Total oil production from the North Slope currently averages approximately 1.6 million barrels per day. This production accounts for about 20% of the nation's domestically produced crude oil and about 10% of daily domestic consumption. All North Slope oil is transported through the Trans-Alaska Pipeline System (TAPS) from the gathering centers on the North Slope to the storage and transfer facilities at Valdez, Alaska. *Figure 2, pie charts.*

- The bulk of ANS production is from the supergiant Prudhoe Bay and Kuparuk River oil fields. *Figure 3: Production decline curves for Prudhoe Bay, Kuparuk River, and total Alaska North Slope.*

Undeveloped Accumulations

- There are presently 24 ~~31~~ known, but undeveloped, North Slope oil and gas accumulations. *Figure 4: Undeveloped North Slope Oil and Gas Accumulations (January 1, 1990).*

- Although some of these accumulations are quite large, such as Point Thomson and Seal Island, high development costs have made development uneconomic at this time.

- Although the Point McIntyre and Niakuk fields are close to infrastructure, environmental concerns over causeways have halted development for the near future.

Projected North Slope Production, Including Undiscovered Resources

- *Figure 5* shows total projected North Slope production to the year 2015 and takes into account the contributions of fields we anticipate to come into production in the near future; it also shows the potential impact on the projected North Slope production decline curves, which could occur from a large discovery in ANWR.

- Undiscovered oil and gas resources of arctic Alaska have been estimated by a number of government, private and industry experts through the years. The data upon which these estimates have been based are generally good, and include extensive seismic surveys, exploratory and development drilling, and surface fieldwork. However, we must remember that there is a high degree of uncertainty attached to any such estimates.

- It is clear that arctic Alaska is comprised of a number of areas with very high oil and gas potential, including the onshore North Slope lands, the Beaufort Sea, the Chukchi Sea, and the 1002 coastal plain portion of ANWR. *Figure 6, North Slope Map.*

- It will require on the order of 7 to 12 years, or longer, to bring a new discovery in arctic Alaska into production. In addition, the high operating costs in Alaska -- where a single exploratory well can cost between $10 and $50 million -- will, in part, dictate which new accumulations can ultimately be developed. Small discoveries, if favorably located, may be economic if developed together or if they can be "piggy backed" on to current production. Large stand-alone discoveries will have to meet a "minimum economic field size" (MEFS) to justify their development. *Figure 7 (Res. Evul. timeline with pictures of rigs, etc.)*

- Clearly, exploration is "on track" and underway in many of the high potential arctic Alaska areas, including the Chukchi Sea. Exploration and development in ANWR, however, is currently on hold due to environmental concerns, even though the Secretary of the Interior recommended the leasing alternative in his 1002 area report to Congress in April 1987.

- Under certain assumptions, it is reasonable to conclude that TAPS will be shut down at some point in the future when operating costs exceed profitability. If this occurs at or near the 300,000 barrel per day production level, and if one has reasonable confidence in the production decline analyses, we can conclude that without new discoveries to bolster anticipated production, TAPS may be uneconomic to operate sometime after 2010.

- It is critical to proceed expeditiously to explore ANWR. The fate of ANWR's petroleum reserves, if they exist, is inexorably tied to the timing of the exploration and development activities now playing out on Alaska's North Slope. A "non-decision" which further delays leasing in ANWR may be the death knell for the supergiant Point Thomson field, the Hammerhead discovery and others, as well as for ANWR, itself.

Major Conflicts Concerning NS Development

- Balance. There must be a balance between development and environmental protection. Marginal increases in the degree of environmental protection should be weighed against the benefits of increasing domestic production. Reaction to the Iraq–Kuwait crisis clearly illustrates that a balanced and timely treatment of controversial exploration and development issues is in the publics' best interest. A "crisis-response" type of national energy policy cannot succeed.

- Wetlands. Proposed constraints on development of Alaska's wetlands continue to be the subject of local and national technical and policy debate and resolution. The President's "no net loss" policy could have severe implications for oil and gas development in Alaska, as virtually the entire North Slope is classified as wetlands.

- Causeways. Conflicting environmental goals exist between government agencies. The causeway issue is an example of this dilemma. While causeways may result in minor changes in oceanographic processes, these changes could be insignificant compared to the potential difficulty of containing a spill from a subsea pipeline.

- Whales (Seasonal Drilling Restriction). In March 1990, the state adopted a new Beaufort Sea seasonal drilling policy. The North Slope Borough (NSB) has since adopted a more strict policy. The differences have yet to be resolved. The NSB is also opposing any offshore drilling operations which use drillships - currently the only way to drill in the deeper water areas of the Beaufort and Chukchi Seas - and most offshore drilling in the summer months. Negotiations between the NSB, the state, the oil industry and the federal Minerals Management Service are continuing.

- Gravel Fill Controversy. On the Colville River Delta, west of the Kuparuk River field and where a discovery well was drilled in 1986 by Texaco, the U. S. Environmental Protection Agency and the Corps of Engineers have identified more than 50 percent of the delta as unsuitable for gravel fill. This could seriously impede development of this prospective region of the North Slope.

- The timely resolution of these types of issues is critical.

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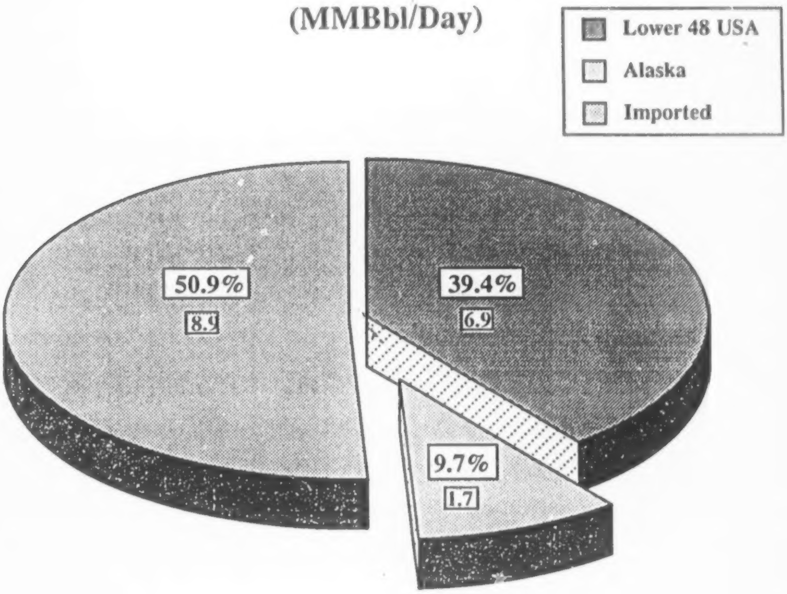
Currently Producing North Slope Oil and Gas Fields

As of January 1, 1990

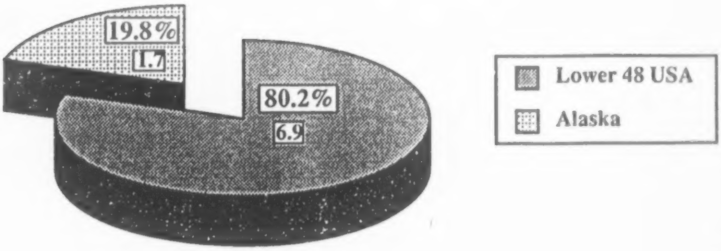
Field Name	Discovered	Estimated Original Recoverable Reserves	Remaining Reserves
1. South Barrow	1949	25.2 BCF	5 BCF
2. Prudhoe Bay	1967	28,500 BCF 9590 MMBO	25,840 BCF 4700 MMBO
3. Prudhoe Bay (Lisburne Pool)	1967	≈635 BCF 400 MMBO	888 BCF 150 MMBO
4. Kuparuk River	1969	640 BCF 1600 MMBO	520 BCF 885 MMBO
5. Milne Point	1969	0 ≈60 MMBO	0 50 MMBO
6. East Barrow	1974	12.4 BCF	7 BCF
7. Endicott	1978	731 BCF 375 MMBO	782 BCF 280 MMBO
TOTALS		35,543.6 BCF 12,375 MMBO	28,042 BCF 6,065 MMBO

* BCF — Billion Cubic Feet of Gas
MMBO — Million Barrels of Oil

Figure 1



US Daily Oil Supply, 1990
(MMBbl/Day)

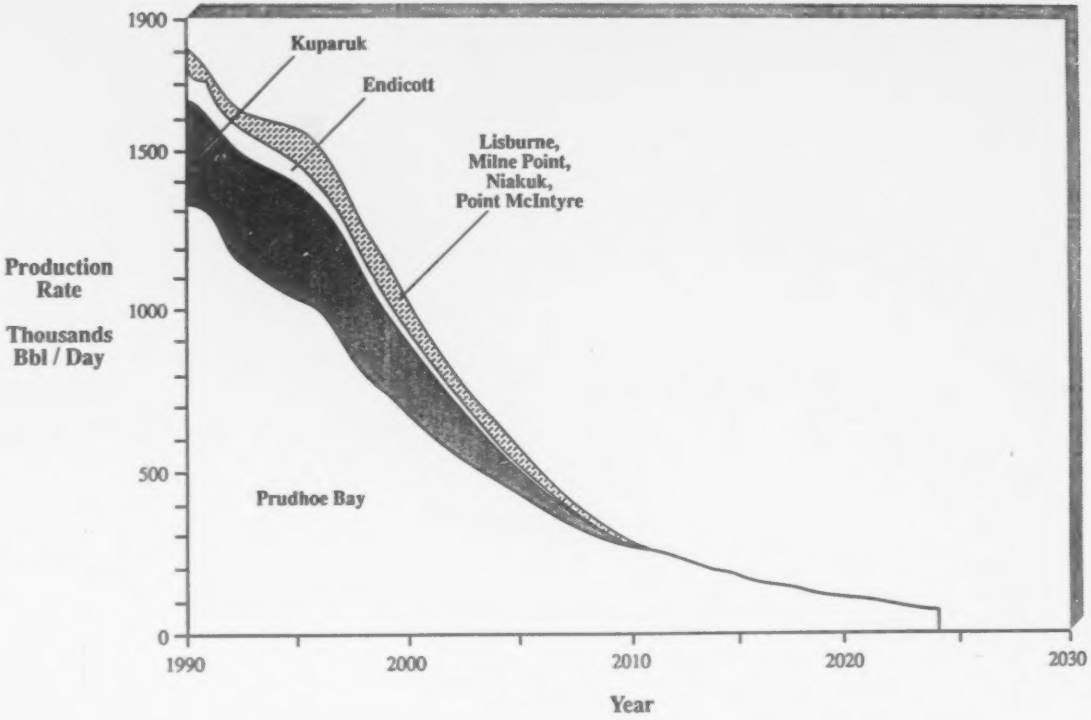


Domestic Oil Production, 1990
(MMBbl/Day)

Figure 2

Production Decline Curve North Slope

Production Rate vs Time



Modified from Oil and Gas Resources of Arctic Alaska: Present and Future, DOE, (In press).

Figure 3

Undeveloped North Slope Oil and Gas Accumulations

As of January 1, 1990

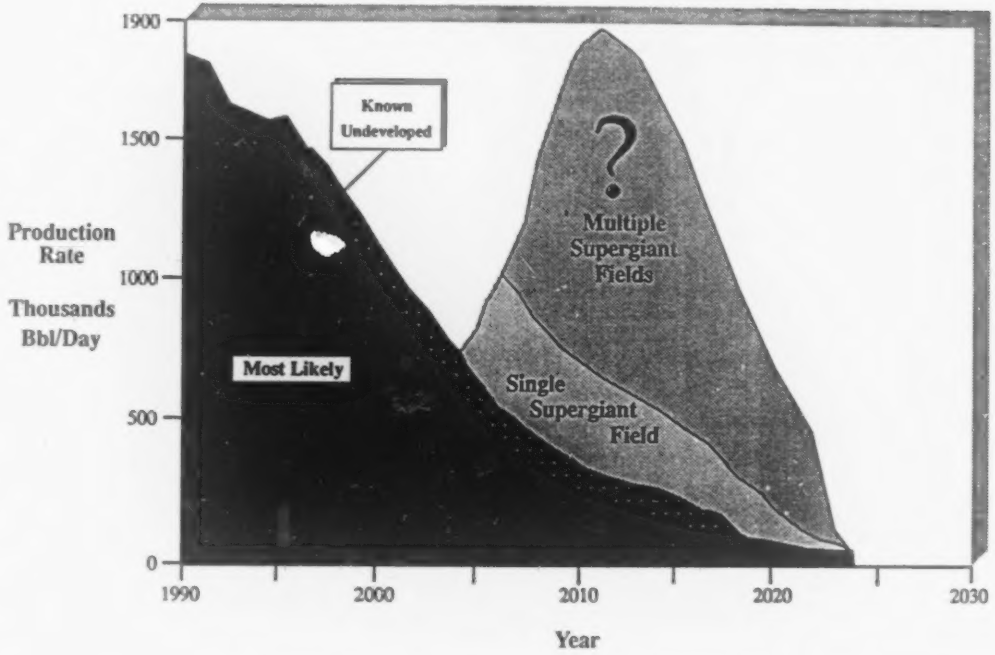
Name	Discovered	Estimated Recoverable Reserves
8. Umiat	1946	50 MMBO
9. Fish Creek	1949	?? (Oil)
10. Simpson	1950	12 MMBO
11. Meade	1950	20 BCF
12. Wolf Creek	1951	?? (Gas)
13. Gubik	1951	600 BCF
14. Square Lake	1952	58 BCF
15. E. Umiat	1963	?? (Gas)
16. West Sak	1969	?? (Oil)
17. Kavik	1969	?? (Gas)
18. Kemik	1972	?? (Gas)
19. Flaxman Island	1975	?? (Oil)
20. Pt. Thomson	1977	5000 BCF 300 MMBO
21. Mikkelsen	1978	?? (Oil)
22. Walakpa	1980	?? (Gas)
23. Gwydyr Bay	1981	< 50 MMBO
24. Tern Island	1983	?? (Oil)
25. Seal Island	1984	150 MMBO
26. Hemi Springs	1984	?? (Oil)
27. Colville Delta	1985	?? (Oil)
28. Niakuk	1985	50 MMBO
29. Hammerhead	1986	?? (Oil)
30. Sandpiper Island	1986	?? CONFIDENTIAL
31. Pt. McIntyre	1988	200 MMBO

* BCF – Billion Cubic Feet of Gas
MMBO – Million Barrels of Oil

Figure 4

Projection Of Total North Slope Production

Estimate Includes Possible ANWR Production,
(High And Intermediate Cases)



Modified from Oil and Gas Resources of Arctic Alaska: Present and Future, DOE, (In press).

Figure 5

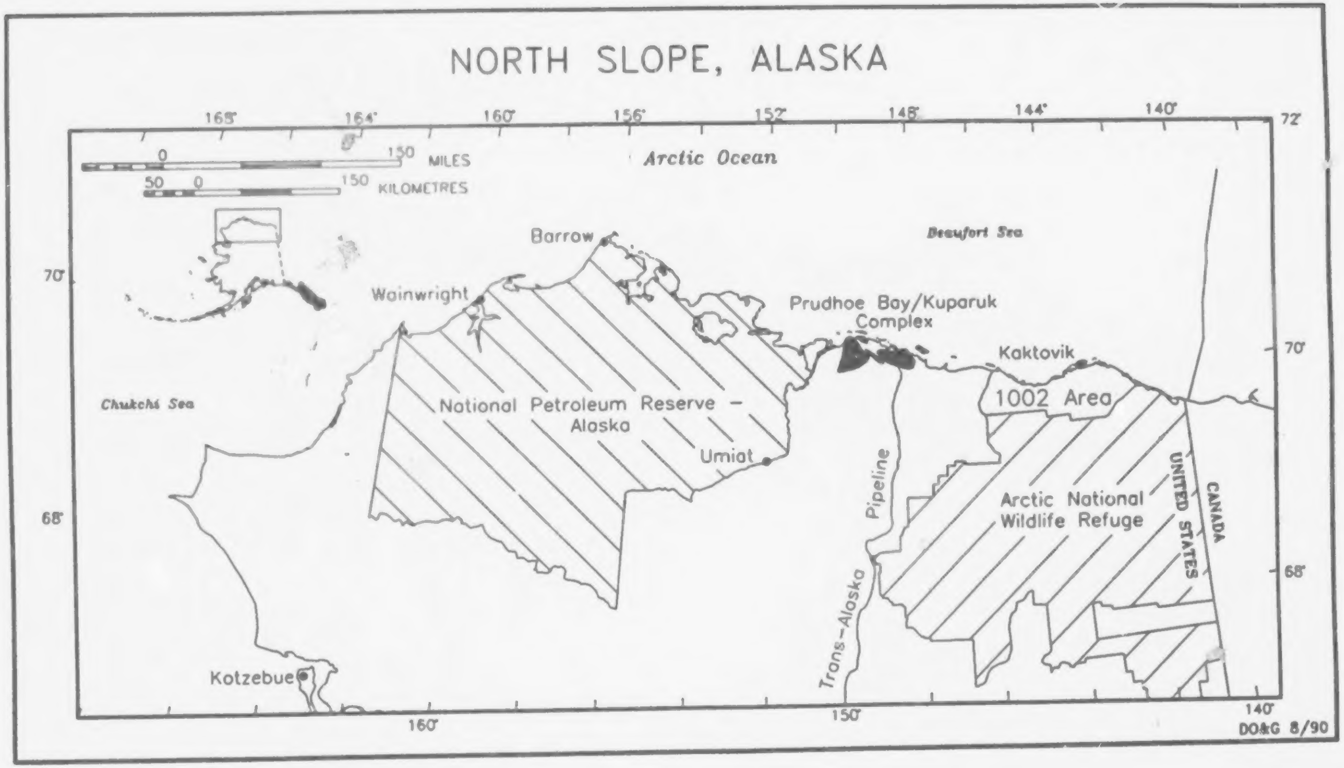

NORTH SLOPE, ALASKA
168°
164°
160°
156°
152°
148°
144°
140°
72°
70°
68°
0
150 MILES
50
0
150 KILOMETRES
Arctic Ocean
Beaufort Sea
Chukchi Sea
Barrow
Wainwright
Prudhoe Bay/Kuparuk Complex
Kaktovik
1002 Area
National Petroleum Reserve – Alaska
Umiat
Pipeline
Trans–Alaska
Arctic National Wildlife Refuge
UNITED STATES
CANADA
Kotzebue
160°
150°
140°
DO&G 8/90

Figure 6

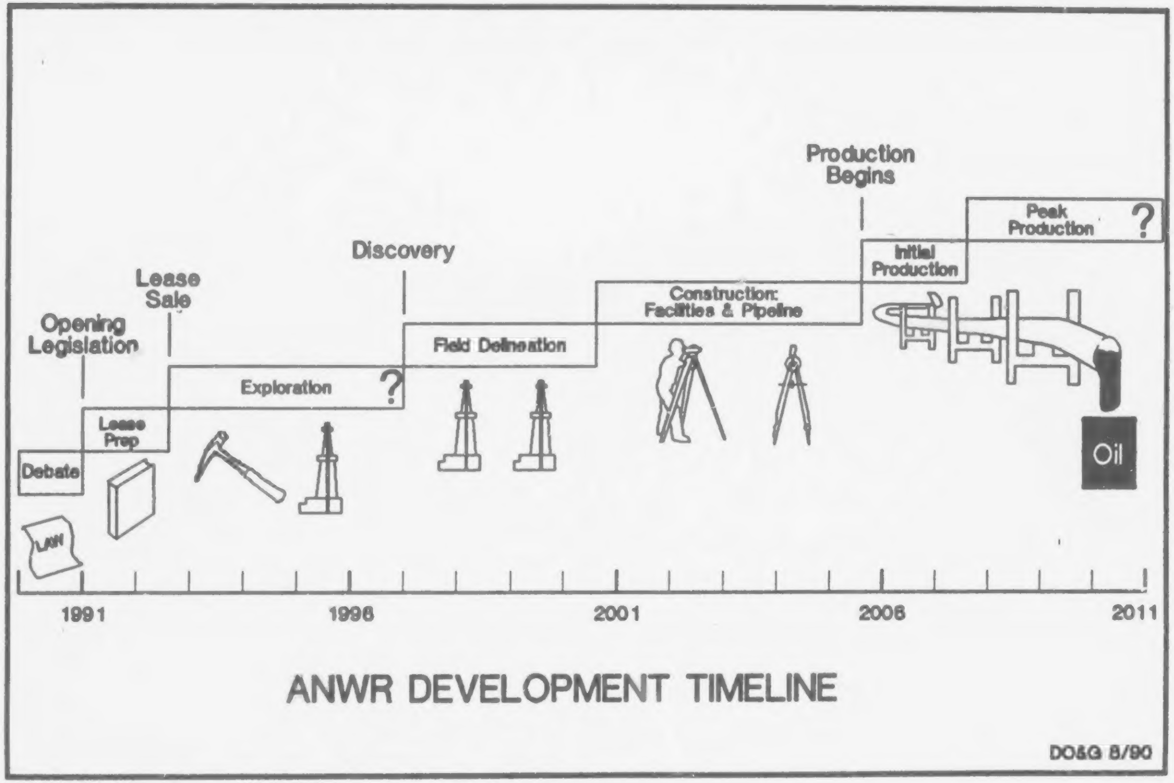

Opening
Legislation
Lease
Sale
Discovery
Production
Begins
Debate
Lease
Prep
Exploration
?
Field Delineation
Construction:
Facilities & Pipeline
Initial
Production
Peak
Production
?
LAW
Oil
1991
1996
2001
2006
2011
ANWR DEVELOPMENT TIMELINE
DO&G 8/90

Figure 7

Insuring Against Economic Upheaval: The Use of ~~Oil~~ Stockpiles in an Uncertain World

A Report to
The International Energy Agency
September, 1984

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Executive Summary

The probability of an energy emergency, triggered by an interruption in oil supply, does not appear to be great today. World oil demand is still depressed, and production capacity exceeds demand by several million barrels per day. Assuming that all nations behave rationally and in what would appear to be their long-term interests, the threat of a significant oil interruption seems comfortably remote.

A risk of serious economic disturbance nonetheless exists: one which the industrial nations might not be able to handle appropriately. The risk would occur from an interruption that is unusually deep or prolonged. Moreover, the nature of the risk itself may have changed since the last decade—earlier interruptions have been primarily political in nature, capable of being started and finished by government decision. Today a quite likely case is that of an interruption which is *physical* in nature, created by military or paramilitary events. It is more difficult to assess the probability of such an interruption, but such an event could remove important facilities from operation for prolonged periods of time.

The major problem is less of an energy crisis than it is of an *economic* crisis triggered by a sharp rise in energy prices. That is precisely what happened in 1979, and it could happen again. The spot market has now evolved into a spot-short term market, and it has grown enormously in the last ten years: it accounted for roughly 5% of international crude oil sales in 1973, 8-9% in 1979, and today it may cover as much as 60% of these sales. While the market is correspondingly wider and therefore less subject to fluctuation as a result of a relatively small increase in sales, it is still volatile, and this volatility appears to have been intensified by the creation of an oil futures market.

A moderate rise in the price of the marginal barrel of oil could spell trouble for all nations; a sharp increase would almost certainly create major problems. Nor is it necessary for an interruption to reach the magnitude of the 7% interruption contemplated in the International Energy Program: the 1979 disturbance involved a drop in production of around 5%, and its economic effects are still being felt.

If the industrialized nations can coordinate their response to an oil interruption—perhaps even one that is relatively deep or perceived as being more than transitory in nature—it appears that they could handle it with relative comfort. This resilience, however, is likely to diminish over time, as demand for oil and its products continues to grow. And a coordinated response may be more difficult to achieve than it appears to be at first glance. If we prove unable to coordinate our reactions, the resulting circumstances could prove to be very bad economic news indeed.

The strategies available to energy-consuming nations for dealing with an interruption in oil supply are not extensive: switch to other fuels, increase domestic production, restrain demand or draw upon stockpiles already in place. For the most part, and for most countries, these in effect narrow down to the last two choices. Some have expressed a preference for the former option and others for the latter. The difficulty lies in harmonizing the two responses.

Demand restraint is a respectable and valuable tool for dealing with energy emergencies. Some countries can do it well, and others have done not so well. By its nature, however, demand restraint takes time to develop and mature—as much as a half year or more from the time that a decision is made to adopt the strategy. Except to the extent that demand restraint is seen as potentially significant, and therefore an important factor to be calculated in estimating a country's need for additional supplies of oil in the future, the inevitable political resistance and time lags inherent in implementing a demand restraint strategy will constrain its ability to discourage a sharp price increase in crude oil acquisition, just as they have done in the past. Its strength lies in the fact that it can be deployed and used over an extended period of time, until the international energy system has reached a new state of equilibrium; its weakness is that it is not well suited to a quick response to an energy interruption.

Stock drawdown suffers no such disability. Stocks can be used early in a disturbance—long before the ships that would have carried the new oil would have arrived at the docks. Stock drawdown can be measured and verified in a way that is difficult or impossible for demand restraint measures. And, effectively used, it can serve to damp the first swings in the price of oil, before the marginal price of the barrel has begun a steep, and perhaps irreversible, increase. The corresponding problem, however, is that stock draw cannot go on indefinitely—in a prolonged disturbance, stocks will deplete, and the more depleted they become, the more painful it will be to draw the next barrel out of the reserve.

The two strategies are complementary, rather than antithetical: both have strengths and both have drawbacks. The problem lies in finding a method to harmonize them, so that their weaknesses can be minimized and their strengths integrated. Harmonizing the two options is likely to be difficult in the event of an actual interruption; but unless we are able to develop a system for doing this before an interruption occurs, we will have no other choice but to do so in the middle of the storm.

The IEA nations have agreed, in principle, on a number of steps looking toward a coordinated strategy for dealing with the early stages of an energy disruption. We believe that it would be useful to pursue this issue, to see if it is possible to achieve more precision in defining how such a system might work. In this respect, we make several recommendations:

1. Some countries have authority only to urge voluntary compliance with good energy practice during an oil interruption, unless and until the IEP 7% interruption has occurred. Because events have demonstrated that the so-called "subcrisis" situation can be almost as damaging to the international economy, we recommend that each country review its own authorities to be certain that its authorities in a subcrisis will be adequate to meet demands that might be placed upon them.

2. We recommend that countries consider adding a small increment to existing oil stocks which would be designated as subject to quick and expedited drawdown in the event of an interruption, to prevent sudden price hikes and consequent economic damage.

3. If this suggestion proves to be politically unrealistic today (as appears to be the case in most countries), we recommend as an alternative that countries consider designating part of their existing oil stocks as appropriate for use early in a crisis.

In the last analysis, the question which the IEA countries must confront is whether the cost of the added "insurance" which these measures would provide is worth the added assurance that future oil interruptions, if and when they occur, will not once again create the economic havoc to which the world was subjected in the decade of the 1970s. This question should be addressed directly.

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Preface

This Study reflects a brief review of an extraordinarily complicated and intricate problem. The Keystone Center, a Colorado not-for-profit organization, has been involved for years in creating a process designed to build consensus among various interest groups on important public issues. This project is an outgrowth of work begun several years ago on the implications of an energy emergency in the United States. One of the major conclusions of the earlier work was that the use of the U.S. Strategic Petroleum Reserve would be very important, and that this Reserve ought to be used not as a matter of last resort, but early in a crisis, to damp the price escalation that would otherwise occur.

It was natural enough to follow this line of inquiry into the international system—to see how that system would respond to a serious crisis. Accordingly, the Keystone Center contacted Dr. Ulf Lantzke, then Executive Director of the International Energy Agency, to see if the IEA would be interested in supporting a modest study on this question. Dr. Lantzke was encouraging, and support from the IEA, coupled with assistance from the U.S. Department of Energy, started the project in motion. The German Marshall Fund of the United States also contributed important support and encouragement to the project.

The Report is a highly subjective and personal response on the part of the principal investigator for the Project. Frank M. Potter, Jr., on leave from his position as Staff Director and Chief Counsel of the House of Representatives' Committee on Energy and Commerce, has been involved as an observer of the process of developing energy policy for several years. His conclusions, and ours, are that the risks which another energy disturbance could present to society are very large indeed. We believe that valuable efforts are already being made to reduce those risks, but that more could and perhaps should be done. The decisions to be made cannot be made unilaterally but will involve government, industry and other decisionmakers, acting in concert.

Preliminary work on this study began in April 1984, following informal discussions with the Executive Director of the International Energy Agency. The study, as outlined in general, was to be an independent and unofficial analysis of the present status and vulnerability of certain of the OECD countries to a new oil interruption.

As originally proposed, the study was to involve a summary review of the status of emergency oil stocks and the policies of the countries examined to respond to a significant interruption of oil which might be, but need not be, at the 7% IEP trigger level. We were requested to examine the background of those policies and to evaluate the kinds of stresses that might be imposed upon them in the event of an oil interruption. As the study progressed, it became apparent to the contractor and to the IEA that other issues might arise in the course of analysis which ought to be included within the scope of examination. Accordingly, the study was extended an additional two months to allow a more intensive analysis of additional questions.

Background of Study

Until the decade of the 1970s, energy had not emerged as a serious peacetime problem, in the sense that its availability and price might create serious and widespread international confrontation. That period of time ended abruptly with the OPEC embargo of 1973. The world since then has not been the same, and it will never be the same again.

This report makes no effort to describe the upheavals that followed the 1973 embargo, or to resolve the implications of the 1979 and 1980 interruptions. That has been done in greater detail and more reflectively elsewhere. Instead its purpose is to look, in general terms, at the present energy situation in several of the major energy consuming nations, with a view to identifying the ways in which the developed economies might react to a further interruption of oil supply. Particular emphasis was given to the use of oil stockpiles as an element in any proposed solution to the problem.

In order to do this meaningfully, however, some background information may be useful. In 1973, the world price of oil, which had been around $3.50 per barrel, rose precipitously to an average price of $11.00 within 4 months. Coupled with this rise in prices came destination restrictions imposed by the producing nations, as a means of calling attention to certain political judgments they wished to make.

These restrictions proved impossible to enforce and the price increases proved impossible to avoid: the real cost of energy had found a new level.

The energy-consuming nations, and particularly the industrialized nations, considered this to be a time to get their own energy houses into some semblance of order, and their response was to create the International Energy Agency within the OECD in Paris with most, but not all, of the members of OECD as members of the new energy agency. As a means of enforcing the kind of solidarity of response which was considered to be necessary to respond to a new energy crisis, the member nations negotiated and signed an agreement on how they might respond to another energy crisis. This agreement, the International Energy Program (IEP), was established to bring certain automatic actions into effect in the event of a new oil shortfall amounting to 7% of recent oil consumption within any member country.

In 1979, with the fall of the Shah of Iran, a new energy crisis arose. Iranian production was severely limited, and although oil production was increased in other oil-producing nations, there was a net shortfall of approximately 5%—not enough to trigger the IEP, but enough to send prices into another sharp rise.

In 1980, a year after the fall of the Shah, war broke out between Iran and Iraq, and oil production was cut once again. This time, however, an almost identical drop in net production went almost unnoticed, except for a brief flurry in spot market prices, which receded relatively quickly. Knowledgeable analysts have suggested that the world price of oil might have dropped much more quickly than it did, had the war not broken out. We will never know for certain. We do know that oil prices did not take off again and that the economic damage done in 1973 and 1979 was not repeated and perhaps even multiplied.

By 1981, it had begun to be clear that a 7% interruption need not occur for there to be an energy crisis of sufficient gravity to demand the attention of policymakers: the "subcrisis" scenarios began to receive closer attention. In December 1981, the Governing Board of the IEA reached a decision to require prompt action, in the event of a supply disruption, of whatever magnitude, which threatened to cause serious economic damage. In such a case, it was agreed that the Governing Board would meet and agree upon a variety of measures which might be applied by Member Countries in order to reach an agreed-upon result.

This agreement did not eliminate the concern expressed about the potential economic damage that might be created by a new energy crisis, whether or not of the 7% magnitude that had been settled upon in 1974. A series of meetings was held with a focus on the particular role that oil stocks might play in dealing with such an eventuality. The culmination of these meetings was a new decision by the Governing Board in July, 1984, which addressed itself to the need for an agreed policy regarding stock draw during significant supply disruptions.

Once again, no definitive decision was taken on the use of oil stocks, nor could it have been, given the variety of scenarios that might require coordinated international action. It was agreed that governments should meet early in a crisis, that stock draws could be an important tool for dealing with such a problem, that a consultative process should be quickly established to decide who could draw stocks and under what circumstances, that Member Countries that cannot presently meet their stock obligations under the IEP should intensify their efforts to do so, and should increase their efforts to be in a position to contribute meaningfully to a coordinated stockdraw program.

There are many different interpretations of the events of 1979 and 1980, and the reasons the crisis produced the enormous and unfortunate economic effects that it did. There are almost as many after-the-fact analyses of what was and was not done and what should or should not have been done. What is not disputed is that the 1979-80 energy crisis either accelerated or precipitated an economic downturn for all nations, in terms of domestic trade, export markets, balance of payments, unemployment, inflation, and virtually any other economic indicator that one might care to mention.

Nor, in the long run, was this effect advantageous to the oil-producing nations. Far from being a zero-sum game, it was a game in which everyone ultimately lost. It is a game that, as far as can be seen, no one wants to play again. Many people consider, however, that it *will be played* again unless we manage to change the rules, or at least to improve the state of the playing field.

Major Questions Examined

It is as important to describe what the study does not attempt to do as it is to describe its general purposes. It is necessary, therefore, to point out that this study is *not*

- an analysis of all IEA or OECD countries,
- a detailed analysis of the energy situation in any country, or
- an attempt to make a prediction or projection of the course of events in any given scenario.

The study is rather an effort to present a first-stage analysis of the state of readiness in several major energy-consuming countries to deal with a serious interruption of their oil supplies. The conclusion of the study, not surprisingly, is that no definite conclusions may be drawn—that an interruption *need* not be extremely damaging to the world economy, but that it *might* be, if we are unlucky or maladroit.

In a number of OECD countries, present policies for dealing with a potential interruption of oil supply are centered around the concept of demand restraint—of reducing the daily requirement for oil and its products to a level which will allow a nation to operate at or near its customary level of efficiency without a severe impact upon its energy system or its economy in general. Other countries have concluded that a more appropriate and desirable method of dealing with such an eventuality is to concentrate on the other side of the demand/supply equation: by drawing down stocks that have been built up to meet this kind of problem.

The two strategies are often seen as antithetical: use one or use the other. In fact, it makes more sense to view them as complementary. Stock draws can be used early in an emergency, to prevent the economic swings that have proved so damaging in the past. They cannot, however, be used indefinitely, and as each barrel is withdrawn from the stockpile, it becomes that much more difficult to withdraw the next. Demand restraint, on the other hand, is not normally a strategy which can be easily or quickly invoked—demand restraint takes time to put into place and time before its effects can be accurately gauged. It is better suited to a long run response to an energy disruption, since it can be used as long as the need is there. Its use is not without economic cost, to be sure, but any significant energy interruption will carry large economic costs, and the job the industrialized countries will face will be one of spreading those costs in a way that will be least damaging for everyone.

Both strategies have their advantages and their prophets. Both strategies may be required in the event of a serious interruption—one providing a quick and definable response and the other providing a longer term reaction to an interruption which might last a long time.

Formal integration of these measures between countries may be difficult to achieve. The complications of harmonizing basically different approaches to a problem which all concede to be serious are difficult enough in abstract terms, at a time when the international energy system is not under particular stress—when in fact energy prices are level or perhaps even declining. How much more difficult will it be to achieve trust and confidence among nations in the event of an interruption, when time and circumstances would combine to multiply that stress exponentially?

Yet the paradox is that, unless it is possible to achieve adequate trust and confidence prior to the time when it is required, it will have to be developed in the middle of the kind of situation which must test that trust and confidence in the extreme, when public pressure in each country will be at its greatest, and when that pressure is unlikely to encourage cooperative and effective international action.

The IEA was created to respond to this kind of problem: it serves as a forum in which energy-consuming countries can meet and discuss strategies for dealing with energy emergencies, as well as a central repository for the collection of data. Its ability to deal with emergencies has never been put to a formal test. If the IEP 7% trigger is ever drawn—as some suspect that it will not be, except perhaps during the transition to a much deeper interruption—the IEP might not work at all. We cannot be sure and would prefer not to have to learn through experience. Certainly it would seem wise to prepare for a series of events which could begin at below the 7% level and build beyond it—probably rapidly.

An Historical and Present Energy Perspective

Access to a reliable and cheap source of energy has always been an important goal for individuals, states and nations. Wars have been fought over energy. Misunderstandings have escalated into deep disputes, and major diplomatic initiatives have been launched to encourage nations to follow alternative courses of action—as in the case of the Soviet gas pipeline in the early 1980s. Respected analysts have suggested that the issue of energy played a key role in the events that gave rise to World War II, and energy played a critical role in the resolution of that conflict.

While the price and availability of energy are important enough in and of themselves, the events of the past ten years have shown that their indirect impact upon national economic indicators can be even more significant. The economic recessions that started in 1973, began to moderate but then deepened in 1979 and 1980, can be traced directly to the events of the 1973 oil embargo and the 1979 Iranian revolution. Their toll, measured in terms of adverse trade balances, decreased productivity, inflation and unemployment—the Four Horsemen of the Economic Apocalypse—is undeniable.

Energy and energy policy have become too important to be left to unilateral decisions by policymakers whose only concern is energy. One may speculate upon the likely course of events had the 1980 Iraq-Iran war resulted in another price escalation, or if current events in the Persian Gulf were to precipitate another, but one cannot doubt that the consequences would be serious indeed. Not only would trucks not roll, but economies would stagnate, banking systems would be badly shaken, and governments could fall. Just how these events would play out cannot be predicted, but it cannot be doubted that we would be living in interesting times indeed.

Is this scenario likely? Probably not. The energy situation today is, as will be discussed below, risky, but we may have learned useful things in the past ten years. The most likely kinds of interruption would involve significant amounts of lost production, but oil demand is still depressed in the world, there is a considerable amount of excess production capacity outside the Persian Gulf, and the world energy system still seems to have enough resilience to handle the most probable oil interruption scenarios. If there were an interruption this year, or next year, and if that interruption were seen as limited in effect or in time, we would hazard an educated guess that it would not produce a major economic upheaval.

This judgment, of course, does not and cannot take any account of that most difficult of all elements to predict: public panic. We have learned, painfully, that the universal response to a perceived oil shortage is to build inventories: countries do it, companies do it, and individuals do it. The combination of everyone doing it at the same time is almost guaranteed to produce what no one wants: a deepening shortage.

An interruption that is deep or likely to be drawn out over a period of more than a few months is another problem altogether. If the developed countries are forced to confront that kind of situation today or next year, we might very well be forced to deal with another economic watershed at least as traumatic as the events of 1973 or 1979, and especially so if the existing surplus has begun to diminish. It appears to us that the key to avoiding that scenario lies in the development of international cooperation and close coordination of energy policies. It is for this purpose that the IEA was created, and if there is any hope of effective action in these circumstances, it lies in the hands of the member governments of IEA.

Alternative Response Strategies

Not very many options are available to deal with an oil interruption: nations may decrease demand, increase supply either by expanding indigenous production or by drawing down reserve stocks, or switch to more abundant fuels. It appears that the options of increasing indigenous supply and fuel-switching have only limited value at present. Most OECD countries have negligible oil and gas production capacity, and those that do are, for the most part, operating at or near their potential. The potential for fuel-switching has become less significant in the past few years since countries have already begun the weaning process away from oil, through increased energy efficiency and through use of sources other than oil for the generation of electricity.

In the European Community, for example, the ratio between energy demand and gross domestic product has fallen in the last ten years—on the order of 19% between 1973 and 1982. This is not due entirely to an increase in energy efficiency: manufacturing activity declined during the same years, and energy-intensive industries have declined in activity in most of the developed countries during that period. In the same period of time, we have seen a substantial increase in the use of nuclear power, more use of natural gas and coal and of course, the development of the oil potential of the North Sea. These activities have already had the effect of decreasing the importance of oil to domestic economies, but the corollary is that the remaining uses of oil, principally in the transportation sector, are that much more resistant to further erosion. We have, as it were, squeezed out most of the easy and cheap solutions—the difficult and expensive choices still lie before us. A realistic estimate of the potential of fuel switching in Europe and the United States is probably on the order of 2-3% of total oil consumption; in Japan it may be slightly higher, but the figures are sketchy.

This leaves demand restraint and stock drawdown as the principal weapons in the arsenal of the energy-consuming countries. While each strategy has much to say for it, and while it seems clear that, to one degree or another, both will be used in every OECD country in the event of an oil interruption, it could be difficult to integrate and harmonize these strategies in an interruption. They operate in different ways and on different segments of the economic system and their use involves considerably different impacts on the behavior of economic systems over time. International political questions can quickly arise: who is to move first; how can Country A be sure that Country B, which is following a different strategy, is not taking advantage of the situation to improve its economic position, or at least that everyone is suffering more or less equally; and how are these facts to be conveyed to a troubled and suspicious constituency?

We believe that the two different strategies can be reconciled. In fact, it appears that they may have to be reconciled. But it will not be an easy task, and it would be particularly difficult to accomplish in times of stress—another definition of the situation during a new oil crisis.

There is of course a form of demand restraint that is not at all slow to take effect—it is the restraint that exists when there is simply no oil or product to meet the demand in question. It is found in lines at gasoline filing stations, in cold houses and in empty factories. It is the kind of demand restraint—we prefer the term "demand unavailability"—that will take place in a severe interruption unless a better alternative can be found. Demand restraint, as it is used by country governments, and as it is used in this paper, implies a system which allows some discretion as to how the burdens of lessened fuel availability are to be spread within a society. It permits a government to take the necessary steps to protect essential industries, and it requires an individual or an organization to decide whether or not the costs of the fuel in question are too high to bear, given the expected returns for those costs.

Demand Restraint and Stock Drawdown

Demand Restraint

A number of different strategies have been developed over the years for dealing with a shortfall in oil supply. Some of these could be implemented quickly and easily, others much less so. Most of them have been used by one nation or another in the past. A list follows of these measures, together with a rough and unofficial estimate of their impact. They are listed on the next page, in Table 1.

These are some of the measures that have been most often considered in the context of demand restraint. Some appear to be more cosmetic than real, but all have been under serious consideration at one time or another, and may at least have psychological value. In any case, these are the strategies that are available for use by those countries which prefer to emphasize demand restraint.

As to those measures which involve more direct intervention in the marketplace, most countries now have authority to impose them, or to adopt them in relatively short order, if the 7% trigger were pulled. Just how relatively is another question, and identifies one of the major problems with the actual use of demand restraint measures in an emergency: time delays. Before a particular demand restraint strategy may be said to have succeeded in its objective, several steps must be taken and all of them can consume time, (although the time elapsed may vary from country to country and in some cases may be quite short):

- the decision must be made that demand restraint measures are appropriate,

Potential Response to Demand Restraint Strategies

	Measure	*Impact*
•	Publicity encouraging economy	Difficult to estimate
•	Fuel switching	2—3%
•	Acceleration of energy conservation programs	Limited effect
•	Gov't economy measures	1-2% at most
•	Adoption/enforcement of speed limits	< 1%
•	Heating/cooling limits	1-2% in heating oil, < 1% in electricity
•	Ban on outdoor advertising	Psychological, negligible energy effects
•	Easing air pollution requirements	Little effect on energy use, but allows use of more fuels
•	Tightening air traffic transportation	Difficult to estimate
•	Compulsory regulation of oil burners	Potentially great effect, but delays involved
•	Restrictions on driving weekends, etc.	Difficult to estimate
•	Limitation of heating oil deliveries	ECC projects a 10% cut as saving: 0-1% heavy fuel oil 3-5% middle dist. 1-2% kerosene
•	Reduction of deliveries of gasoline to filling stations and major consumers	Substantial
•	Fuel rationing	Substantial

Table 1

- the strategies must be chosen,
- if necessary, the authority to implement those strategies must be acquired,
- the strategies must be adopted,
- the strategies must take effect, and
- the impact of those strategies must be assessed and reported.

This is not to suggest that demand restraint measures are inappropriate in the proper case—just to say that their effects are never instantaneous, and that the inevitable lapse of time could be damaging in some cases.

There are further problems with the use of demand restraint measures in a situation where several nations are trying to act in concert. These have to do with the way in which the effects of these measures are compared. Assume that Country A and Country B have each agreed to decrease their energy consumption by 5% from January 1 to April 1. Immediately one runs into the question of the baseline against which this target is to be measured: is it to be the first three months of the previous year, is it to be one-fourth of the last year overall, or is it to be 5% less than the requirements that had been projected earlier for the coming year? Further complicating the matter is the fact that rarely are reliable economic data available in any of these cases until a considerable period of time has elapsed, and this information is needed now.

These are not hypothetical problems: they arose in 1979 during these kinds of deliberations and they could very well arise again. Moreover, there is always a certain suspicion that some data which might be embarrassing or accusatory may simply never be gathered or disclosed.

It must also be pointed out that in a subcrisis situation involving less than the 7% IEA trigger, many countries lack the authority today to impose effective demand restraint measures upon their citizens. It is not difficult to imagine circumstances in which this deficiency might prove to be crippling, particularly, and we stress once again, early in a crisis.

For the most part, the same demand restraint strategies that are available today were available in 1979 as well. It may be that the lessons of 1979 were sufficiently clear to persuade countries that demand restraint must be taken more seriously and invoked before systems have begun to go into spasm. It may also be, and we think it more likely, that the time constraints which inhibit early and effective demand restraint measures are such as to make it improbable that they will be invoked and effective early enough in a disruption to prevent serious disturbance.

No system is perfect, it goes without saying, and these potential deficiencies ought not to obscure the fact that demand restraint is a legitimate and valuable tool for dealing with an energy interruption. The point needs to be made that there are problems, and that these can make even more difficult and confrontational a process which is by its nature already difficult enough. It is important to remember that the time when these discussions will be taking place will be a time when the international order is already severely stressed.

Stock Drawdown

This study has concentrated upon the oil stocks of the countries examined, with particular attention given to their present status and availability. A description of each country is attached to this report in Annex I, and the subject will be discussed only generally here.

For the most part, stocks in the OECD countries appear to be in reasonably good condition. The 90-day IEA and EC requirement appears to have been met for most countries (we are aware of no audits which might confirm the accuracy of the figures presented to governments and to the IEA), although the factor of Minimum Operating Requirements (MOR) needs, and is receiving, more analysis. Some countries are holding stocks, however, below the required levels, and they should be encouraged to correct this situation, particularly when and as their economic situations improve.

Some apprehension has been expressed about the accessibility of reserve stocks, but it appears that the United States is at present the only nation in which problems may arise in moving crude oil from the reserve into refineries and then into general circulation. Even here, the problem is now receiving careful attention and, in the event of a crisis, the Department of Energy has informed us that there are no logistical problems which cannot be overcome.

National oil reserves are currently maintained and funded in almost as many ways as there are countries involved. The United States places no obligations upon the oil industry for the maintenance of certain minimum stocks, although it and several other countries have government-owned and funded reserves. More often it is the case that national governments impose these requirements upon industry, although this frequently takes place with the help of government subsidies.

The only countries in which reserves are now being increased are Japan and the United States, and we have seen no indications that this situation is likely to change in the foreseeable future. The high costs of building and maintaining such reserves, coupled with an uncertain international economic situation, have created a situation in which reserve additions are unlikely to occur, barring new international understandings.

How and under what circumstances reserve stocks can be accessed is far from uniform and far from clear. Under existing legislation in several countries, reserve stocks may not be drawn upon unless and until an interruption requiring official intervention takes place—in other words, a case involving the drawing of the IEA 7% trigger. In a "subcrisis" situation, involving a lesser interruption, those countries would find that, even if they were willing and anxious to allow their reserve stocks to be drawn upon, they lack the legal authority to do so, or in the proper case to require that stocks be drawn down. That this could present problems both of access to those stocks and the appearance of comity between nation-states seems undeniable. It would appear to be important for each country to analyze its own ability to respond in subcrisis circumstances.

In the event of an interruption which merited coordinated stock draw activity, the problem of harmonizing drawdowns would not seem to be difficult to resolve. Coupled with that decision would of course be a corresponding agreement among all nations not to use the same time to build up stocks. The Governing Board decision of July 11, 1984 was explicit in this regard and the logic seems inarguable. Given the undisciplined nature of the spot market and the ways in which nations have disguised their oil sales and purchases, such an agreement may be difficult to enforce, but major infractions should quickly become apparent. There are ways of effectively expressing distress over such activities which, under all but extraordinary circumstances, should serve to keep them to an acceptable minimum.

Oil Inventories in Countries Studied

The countries reviewed in the course of this study include the major energy-consuming nations of the world. If, in the face of any conceivable energy crisis, these countries were able to coordinate their activities and act collectively to avoid or minimize the adverse consequences of that crisis, economic and political devastation could probably be avoided. It is also probable that, if they cannot so act, such a crisis would be extremely damaging.

One of the major factors involved in the oil interruptions of the 1970s was the state of crude oil inventories at the time of the interruptions. Inventories were down in 1973 and 1979—and there was a crisis. They were high in 1980—and there was no crisis. (Whether or not there is a necessary connection between these factors is still hotly debated.) Company inventories are lower than they have ever been since 1974, as noted below. The major difference between then and now appears to be that government and entity reserves have expanded to far higher levels than before, and now constitute roughly 20% of total stocks.

These reserves are, as Figure 2 shows, mainly concentrated in a few countries. After taking account of minimum operating inventories, the crude oil stocks available to the OECD nations, as of the end of April, 1984, totalled almost 200 million tons. The United States, Japan, West Germany, Italy and France account for more than 75% of the oil stocks available to the major developed nations—other than the centrally planned economies. This state of affairs has changed significantly in the past few years, principally as the United States has increased its Strategic Petroleum Reserve, mandated in 1973 but seriously enlarged only in the past three years. This is not to say that other countries' contributions have been less significant—they have not. But the United States consumes so much energy that its new status as a major oil reserve holder has come as an immense relief to the other IEA nations.

Of the countries studied, only the United States and Japan have indicated an intention to increase the volume of stocks presently held. By legislative act, the United States has set for itself a goal of 750 million barrels of oil. It is now more than halfway to this goal, and will very likely adopt a fill rate of 186,000 barrels per day for the fiscal year which begins on October 1, 1984 (the Administration prefers a fill rate of 145,000 barrels per day, but is consistently overridden by the Congress).

Japan has embarked upon an aggressive program to increase its oil reserves, doubling the present reserves held by the government before April 1988. Today 22% of Japan's reserves are held by the government and the rest are held by private industry. If the industry stocks stayed the same, and government stocks were to increase to the target of 30 million kiloliters (25.5 MT), the percentage of ownership in the government would increase to almost 40% of the total.

Figure 1, derived from IEA data, shows opening stock levels within the OECD at the beginning of each year from 1974 to 1984 for government, entity and company stocks. Opening company stocks in January 1974 were 337.5 million tons (MT); on January 1, 1984, they were 327.2 MT. In the same period of time, government stocks increased from .3 MT to 76.9 MT, and entity stocks from 1 MT to 20.7 MT. The highest stock levels in the decade were registered in the fourth quarter of 1980 (496.7 MT), and the lowest levels since 1980 occurred a year ago, in the third quarter of 1983 (420.1 MT).

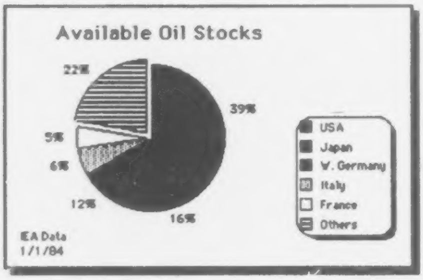

Figure 1

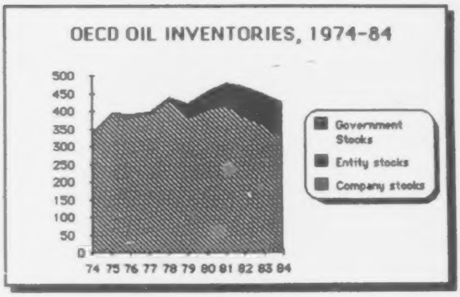

Figure 2

Figure 2 is also derived from IEA data and shows available stocks within the OECD as of April 1, 1984 (185.2 MT). For this purpose, available stocks has been defined as government-owned stocks, entity stocks and oil company stocks in excess of estimated Minimum Operating Requirements. Ten percent of government-owned stocks were arbitrarily deducted as unavailable in tank bottoms, etc. The oil company stock figures include stocks held by government-owned companies and certain large consumers, such as utilities, as required by law or otherwise controlled by governments.

The Spot Market in 1984

No one is entirely certain of the size of the trade in oil today which follows other than traditional long-term contract procedures, but it is apparently very large. The spot market is estimated to have accounted for approximately 5% of the volume of oil traded internationally in 1973, and the conventional wisdom is that this percentage had increased by 1979 to something on the order of 6-8%. Some of the major international oil companies have projected that the size of the spot market (to the extent that it includes longer-term contracts with market-out clauses, short-term contracts and contracts tied in price in some fashion to the spot market) now covers perhaps 60% of international crude oil sales.

There have been discussions within bureaucratic circles for years along the lines of "We really ought to do something about the spot market." Those discussions have never produced a workable answer to the question, nor are they likely to do so. Nor, for that matter, is it at all clear that something should be done. The spot market serves a useful and necessary function, and the price of inhibiting that function might be great. In any case, the question seems moot—we cannot control it, and the only effect of trying to do so is likely to be to make that part of it which escapes control even more volatile than it is today.

In point of fact, it is probably not accurate to describe this as the spot market today, in the sense of the traditional distress sales of cargoes or committed purchases. It may make no difference, however, since the critical element is the short-term nature of the sale, and in this regard, there have been major changes.

A new and important factor may be found in the growth of the oil futures market. What we do not know, and can only guess about, is the way that the oil futures market might interact with the short-term market. Oscillations in the world oil market might well trigger and amplify changes in the futures market, in turn further amplifying fluctuations in spot market sales. Since the price of the marginal barrel of oil is the forcing factor in triggering economic distress, one may without difficulty anticipate that this marginal price might well be ratcheted upwards by the threat or in the event of a serious oil interruption.

The narrowness of the short-term market in 1973 and 1979 contributed substantially to its ability to rachet up the price of crude oil—in the first place for spot market sales alone, but quickly for the sales of all oil and oil products. That market is clearly not as narrow today, and it is somewhat less probable that a few purchases at high prices would begin a cascade of ever-increasing price increases. Oil traders, some of whom have been burned badly in the past several years, are certainly anxious to avoid taking positions which could expose them to large losses.

The other side of the equation, however, is that if and when prices do begin to rise, the economic impacts could rapidly translate themselves into massive economic shocks. A doubling of the spot price was difficult for the world oil market in 1979, but it was not the disaster that it would be today because the volume of existing term contracts kept the average cost of crude oil within tolerable ranges, at least for a time. A doubling of oil prices today would be far more damaging by diminishing the term contract "cushion," and it could spell economic disaster for many countries. How these effects would ripple through the banking and manufacturing sectors of the world economy is a question that no one can predict, but that it could be disastrous no one would deny.

Timing of National Responses

It appears that the risk of unbalancing the spot market is greatest in the early stages of an oil disturbance. If the message, however unspoken and intuitive, is communicated that an interruption is likely to persist, or that its effects may be widespread, a real risk exists that the market may begin to oscillate—or, more likely, to take off for new and higher price levels. This will not happen in hours, and it may not happen in days, but our experience has been that it will happen relatively quickly.

If governments cannot regulate this system, about all that they can do is to try, as best they can, to control the oscillations in the early stages of a disturbance before they have begun to build. A quick response is called for—quick in the sense of consultations, and quick in the sense of response to the situation. EC and IEA procedures call for this kind of consultation: in the early days of an event which is perceived as precipitating a potential energy disturbance, it seems likely that energy officials would rapidly jam the airports in Brussels and Paris.

Are those consultations likely to produce a rapid response, in the sense that the public and the oil trading community would conclude that matters were well in hand, and that inventory buildups, whether in storage tanks or gas tanks, were unnecessary? Here, one can only speculate—and perhaps pray. The situation is simply not one in which rational responses can be expected, however much they may be hoped for. It is our belief that, given the known risks of a serious and perhaps even disastrous rise in world oil prices, governments would be well advised to take every possible step to avoid such a turn of events.

Given the response time necessary to implement either demand restraint measures or stock drawdown procedures, we are strongly of the view that some kind of stock draw system should be adopted which is both credible and rapid. It may not be necessary to draw stocks to any significant extent, and it may not even be necessary to begin the physical process right away. The major effect of such a program would be more psychological than physical, at least in its early stages, in its ability to address the major risk of public and commercial panic.

Demand restraint can work in some political systems and in some circumstances. It cannot, however, take effect instantly, and the need is for rapid response. Stock draws, on the other hand, can be announced immediately, and can take place in a relatively expedited fashion. Further, they can be precisely estimated and delivered, in a way which other governments can observe and even, if this is considered to be important, verify.

Energy demand within the OECD and, for that matter, in the rest of the world has been substantially below the rate of GNP growth for several years. This was due in no small part to the energy events of the past decade. The indicators suggest that, for some countries at least, economic activity is on the upturn, and this will inevitably have effects on demand for oil and other energy sources in the coming years. The present soft market for oil, and the corresponding low price for oil, will not last forever but no one can say when the real price for oil will once again begin to rise. When it does, the energy picture can and probably will change sharply. Changes in the nature and extent of spot market trading, coupled with the development of an oil futures market, will have a strong effect on the price of oil in the future, but it is not yet possible to be more precise on just what that effect will be.

Policy Implications

The international energy system is clearly aware of the value of early stock drawdowns. Enough public discussion of these points—none of which are new or startling--has taken place to make it a concept which is very much in the minds of government and energy industry executives. We are not confident that other industry policymakers and economic advisors are fully aware of the situation, but expect that they will become so over time, as the nature and severity of the risk become clearer. EC discussions have taken place on the nature and dangers of the energy "subcrisis" situation and the IEA Governing Board has considered it and made recommendations, first in December 1981 and most recently on July 11, 1984. Consultations will take place, and governments have been encouraged to take whatever actions they can to avoid early perturbations in the oil market.

The United States has announced in the clearest possible way that it intends to access its crude oil stocks early in a crisis. Secretary Hodel was explicit on this point in his testimony in 1984 before the Committee on Energy and Commerce of the U.S. House of Representatives. Thirty-nine percent of the OECD oil stocks are subject to this decision, and so it must be considered as a vitally important element of the situation. It may not, however, be enough.

Other nations also have oil stocks and this fact has not been lost upon anyone, including the Congress and the American public. A unilateral U.S. decision to access its strategic reserve stocks would be, and is, a politically courageous decision to take. Nor would it be irreversible. Energy policymakers must take account of the fact that a U.S. decision to "go it alone," and to draw down stocks at a time when the majority of the rest of the developed countries were either still considering what to do or were taking actions which the U.S. considers to be ineffective, might not be in the best interests of the country.

Americans tend to regard stock draws as a newer and perhaps shinier weapon than they have had in the past, due no doubt to the fact that until fairly recent times, it was not much of a weapon in the United States at all. Its attractiveness has been considerably enhanced by a fairly dismal history of efforts at demand restraint through governmental action during the past decade, coupled with the fact that the use of the Strategic Petroleum Reserve is entirely consistent with the free market philosophy of the Reagan Administration. For many Americans—voters, Senators and Representatives—the specter of the U.S., alone or in the company of just a few other nations, acting to draw upon its expensively-built and slowly-accumulated oil stocks, would be an open invitation to intervene and to reverse the decision.

If the United States is to persist in its decision to access its oil reserves early in a crisis, it is going to need assurances that it does not stand alone in this endeavor. The July 11, 1984, Governing Board decision was considered, universally as far as we can tell, to be an important step in the right direction. At the time of a crisis, when general and political concerns would be exacerbated, we believe that the cries for more positive action would become deafening, unless they can be quieted by credible evidence that other nations are following similar courses of action and that the international system is actually working.

It would appear to be in everyone's interest to attempt to chart an easier course through waters which all concede to be turbulent. That process is proceeding already and has been for some time. Governing Boards of the IEA have had these matters under discussion for a long time already. Decisions have been taken in December 1981 and in July 1984 which attempt to do this and the process is by no means finished.

Implications of Another Oil Interruption

No one, as we indicated earlier, has yet been able to detail the precise impact of the 1973 and 1979 oil interruptions. There are general data for the OECD nations, and these should serve as well as any to outline the implications of another serious interruption. As also indicated above, we believe that an interruption on the order of 4-5% might be almost as damaging as a deeper one, if the energy-consuming nations were to react unwisely.

The OECD countries spent $35 billion on oil in 1973; that figure went to $141 billion in 1978 and to $291 billion in 1980. A shift of that size in national accounts could not have been ignored by governments, and of course, was not. Inflation and unemployment levels soared during that time, and governments responded by imposing various monetary and fiscal policies. IEA analyses state that the full impact of the resource transfer and the policy-induced contraction of the (OECD) economies was about 5% of GDP in 1980 and 7.5% in 1981. This is equal to $1 trillion ($1 million million) or about $1300 for every individual in the OECD for those two years. Overall, the economic impact of both the 1973 and 1979 oil shocks took about four years to equilibrate, allowing countries again to begin building up their weakened economies, but from a considerably lower base than they would otherwise have had.

We are still paying the price for those interruptions in inflation, unemployment, reduced gross domestic product, adverse balances of trade and virtually any other economic indicator that one might care to mention. What one should do to ease those problems, once an interruption has occurred, is a debate that continues to rage in the world's capitals, but there is absolute unanimity in the view that we would be well advised to avoid them in the future if we possibly can.

Methodology of Country Studies

A number of factors were identified early in the course of the study as having an important bearing upon each country's ability to handle a serious oil interruption. These were discussed with IEA officials and with their assistance, an outline was prepared which identified the central questions. This outline, attached as Annex II, served as the framework for most of the ensuing discussions.

It seemed important to identify some of the critical information on energy supply, energy demand and oil and product storage, and so, with the help of the staff at the IEA, these data were included in the country profiles attached to this study as Annex I.

Armed with draft profiles, we visited each of the countries studied, talking with government officials, representatives of energy companies and, where possible, to journalists and other knowledgeable observers of energy matters in each country. Following the interview process, and armed with whatever documents were made available to us, we reviewed and revised the profiles and forwarded the revisions to the people to whom we had spoken, with requests that they suggest any changes or additions which they felt to be appropriate. While not everyone contacted has responded, we believe that the profiles contain no errors sufficiently large to change their basic information in any significant way.

In the course of the study, it became apparent that a number of subsidiary issues needed to be addressed as well, relating to ways in which existing stocks might be accessed and what the effects of drawing upon those stocks might be. These additional questions were forwarded to knowledgeable officials in each of the countries and their responses have been incorporated into the country profiles.

We have found disagreements on some elements of energy supply and demand in several of the countries involved, or in questions of interpretation of those facts. Time and circumstances make it impossible to resolve those disagreements, so we have simply identified them as "unresolved issues."

In some cases, issues that emerged from the process proved to be controversial, even if the supporting facts were acknowledged to be accurate. While we have tried not to single out any individual or country in the course of the study, we also have felt it necessary to discuss those elements of a country's readiness to handle an oil interruption which would be relevant to an independent observer who wished to form his or her own judgment on those matters.

IEA member countries are required to retain certain stocks levels calculated as a function of days of historical net imports of crude oil; EC members are required to retain stocks, calculated as a function of days of past consumption, calculated on the basis of the previous year. These figures have been identified, using IEA information, for each country in this study after taking account of Minimum Operating Requirements, and listed in each profile under Stock Status.

The data in the profiles in Annex I were provided from OECD sources, as follows:

1982 Energy Balance Data—*Energy Balances of OECD Countries 1970/80*

Oil Share in Electricity Generation—*Annual OECD Electricity Questionnaire*

1983 Oil Use by Main Product—*Quarterly Oil and Gas Statistics of OECD Countries—1984 1st Quarter*

April 1, 1984 Oil Stocks—*Monthly OECD Oil and Gas Questionnaire* (Data will be published in *Quarterly Oil and Gas Statistics of OECD Countries—1984 2nd Quarter.)*

Summary of Country Studies

Germany

Substantial reserves are held by the Federal Government, together with stocks held by EBV, a public stockholding entity, on behalf of private oil refiners and traders in Germany, and stocks held by the companies themselves. Authority exists to allow industry stocks to be drawn or demand restraint measures to be imposed, whether or not the 7% trigger level is reached, although additional steps might have to be taken in the case of specific demand restraint initiatives. Government spokesmen assert that any time delay in obtaining the necessary authorities would be slight.

The German government is considered to be reluctant to draw stocks early in a crisis, before its dimensions have become clearer, although Government officials emphasize that they would expect to make a decision on the basis of the situation at the time and that stock drawdown is an obvious candidate for government action. Industry officials assume that the order of drawdown, in the event that such a step was taken, would be discretionary industry stocks first, then mandatory industry stocks, then EBV stocks and finally, and only as a case of last resort, Government stocks.

We believe that the German government would go along with any decision made within the IEA to deal with an oil interruption, although we would expect some reluctance on the part of the Government to commit to a substantial stock draw program without prior concurrence and participation by other IEA Member countries.

Italy

A high proportion of electricity is still generated by oil-fired plants in Italy—a country which is sensitive to the need to become less dependent upon oil as an energy source, but which faces impressive obstacles in achieving this objective.

Most oil stocks are held in the hands of private companies, and it is unlikely that there would be any increase in the volume of stocks held as emergency reserves unless the Government were to increase its own stockpile. This objective, while seen by some as desirable, is considered by all to be highly unlikely in the foreseeable future, given the weak condition of the Italian economy.

The powers of the Government to deal with an oil emergency are limited until and unless the 7% trigger is drawn. This factor seems especially important in view of the fact that there is a coalition government in Italy, which would have to find consensus before embarking upon as potentially explosive a question as an oil interruption would surely be. Prompt and decisive action seems difficult to achieve.

The Government favors stock draw as an option for dealing with an oil interruption, although there is no direct authority to require stock draws on the part of the oil companies. For one thing, the effects of a stock draw program are seen as far less damaging to the economy. If demand restraint measures were considered to be necessary, they would probably occur first in the form of increased taxes on certain forms of consumption, thereby inhibiting use through the pressures of the market. Oil product prices are controlled by the Government, and industry feels itself to be carrying a substantial burden as a result.

Japan

Japan still uses substantial amounts of oil to generate electricity, but is working hard to reduce this dependence.

Japanese oil companies rely heavily upon oil from the Persian Gulf and consideration is being given to ways of reducing this dependence. The situation seems unlikely, however, to change significantly in the near future.

The Japanese government presently holds substantial stocks of oil, much of it in tankers. While the initial government stocks were all held in this way, this storage is now being phased out, and all government stocks will be transferred to leased and permanent facilities—perhaps as soon as next year. Consideration is also being given to the construction of underground storage, but no final decision has been taken on this question. Stocks held by the Government are increasing; they are projected to double from the present level of 15 kiloliters by fiscal year 1988.

The Government has the power to order the withdrawal of company stocks or to draw upon its own stocks whether or not the 7% trigger amount is reached. It is not at all clear what the sequence of withdrawal would be, although industry representatives believe that government stocks would be used last. Nor is it clear what the circumstances of stock drawdown would be: price, manner of sale, or conditions attached to the sale. The Government is considering all these matters, and has made or at least announced no decision on them.

The Japanese Government is looking at both demand restraint and stock drawdown as options for dealing with an interruption in oil supply. While they would be strongly influenced by decisions made in other countries, in the last resort the decision will be made on the basis of what is considered best for Japan at the time.

The Netherlands

Oil stocks are held by refiners and traders and by a private stockholding entity (ICOVA). ICOVA is scheduled to be converted into a government body soon, perhaps in 1985, although this will not create important changes in the way the system is operated: its principal effects will be seen in the way the reserves are funded, and in the new authority it gives the Government to expand reserve stocks.

The Government lacks authority to draw upon stocks or to impose mandatory demand restraint measures until the 7% trigger figure is reached. Government spokesmen are well aware of the economic problems that may be faced in the event of a subcrisis, and feel that new authorities might be obtained in the proper case, with only relatively small delays in time.

If a significant supply interruption were to take place, it would be our guess that the Government would support and share in a coordinated stock draw program as soon as one were developed, even if the dimensions of the interruption were still not clear. What the oil traders would do is another question altogether—they are an important feature of Dutch economic activity, but they are not under the control of the Government in any significant manner.

Spain

Spain depends heavily upon the use of oil to generate electricity, and there is only a negligible ability to switch to alternate fuels in the near future. Oil stock levels are not as high as those in many other IEA countries, and the Government is aware of and concerned about this situation. Government officials also feel that there is a problem in IEA interpretation of Spanish data and that the imbalance may not be as great as IEA figures suggest. It seems very unlikely that there will be an increase in stocks in the near future.

The Government has the power to require stock drawdowns before the 7% trigger is pulled. The Spanish government has, in fact, extensive authorities to intervene in the economy in the event of an interruption, and these would certainly include the array of measures which are generally considered to be demand restraint options. The Government is supportive of the concept of stock draws as a means of helping keep the international price of oil at reasonable levels. It is felt that Spain would willingly go along with any decision made in the IEA on ways to deal with a significant oil interruption.

United Kingdom

There is no government-owned stockpile of oil in the United Kingdom, and it is not required to keep the full 90 days of reserves, given the fact of UK production capacity. Government officials state that ample authority exists to permit stock draw or demand restraint to take place, even if the 7% trigger amount is not reached.

There is a strong preference within the Government to avoid mandatory demand restraint measures, although these could be imposed if they were considered to be necessary. It is assumed that the preferred response would be to increase production of indigenous oil in the event of an interruption, and to adopt stock draw as the next choice in line. Demand restraint measures would be reserved as a last resort.

The Government states that it is aware of, and concerned with, the implications of a sharp increase in the price of international oil, and wishes to avoid this happening.

United States

The only nondiscretionary oil stocks held in the United States are held in the form of crude oil by the Federal government. The Strategic Petroleum Reserve was authorized in 1975, but the filling of the Reserve was not started until 1978, and it was not until 1981 that accelerated filling of the Reserve took place. The Reserve had reached the sum of 53.2 million tons as of the end of June 1984.

The U.S. government has clearly stated its intent not to engage in demand restraint as a government policy in the event of an oil interruption. While it would expect to use public persuasion to encourage the consuming public to use less oil, and would also take steps to decrease consumption by agencies of the Federal government, it would resist efforts to engage in more coercive measures. The only demand restraint that it would endorse would come in the form of public reaction to higher product prices.

The principal focus of a U.S. response to a significant oil interruption would be in the form of early drawdown of the Strategic Reserve, a policy which was announced only during the incumbency of the present Secretary of Energy. The Government has authority to draw these stocks down before a 7% interruption has taken place, and would expect to do so in the proper case. It is not clear, however, that the U.S. Congress would acquiesce in this policy, particularly if it appeared that other countries were not following a similar course of action.

Conclusions

A few generalizations can be made about the way in which the industrialized nations are likely to respond to a new oil emergency. These generalizations should be examined carefully before any action is taken, but we believe that they appear intuitively correct, and that further analysis is unlikely to change their basic thrust.

Probabilities

Collectively, the OECD countries are in relatively good shape to handle the most likely kind of oil interruption today. Company stocks are lower than they have been since 1974, but government stocks (combined with entity stocks) are higher than they have ever been. Much of this buildup is attributable to high stock levels in the American SPR program, it is true, but many other countries have developed substantial stocks as well. Some countries, however, are not as well prepared, and this could create problems. A major effort by any country to acquire oil at a time when the market is tight could create enough of a surge in demand on the spot market to precipitate a sharp escalation in oil and product prices.

If the industrialized countries respond in a coordinated manner to an interruption, it would probably not produce the kind of economic disturbance that occurred in 1979. The volume of stocks that has been accumulated seems adequate to handle most conceivable interruption scenarios. If the IEA countries are able to coordinate their responses in such a case—those preferring demand restraint by doing so, and those favoring stock draws by orchestrating their drawdown activities—and if all are able to avoid the temptation to build stocks during the early and volatile stages of a crisis, then such a crisis is not likely to be devastating.

The industrialized countries probably cannot successfully resist the early price shocks from a less likely interruption: one which is, or which is perceived at the outset as being, deep or prolonged. Oil interruptions are rarely predictable as to length or their ripple effects as other nations react to them. Whether and how other producing countries will move to ease the impacts of a shortfall is never predictable, nor can anyone be certain how political pressures will develop. Informed industry observers believe that a month-long closure of the Straits of Hormuz, for example, could be survived with minimum inconvenience, *if no one panics.* A lengthy interruption of oil from Saudi Arabia, however improbable it might seem, would create a whole new set of circumstances, and could precipitate a rapid and abrupt price rise in oil which the present international system would not be equipped to accommodate.

It is not possible to anticipate how the world will respond to an oil interruption. The only prediction that one can safely make about the next interruption is that it will involve a combination of factors that no one will have anticipated. For this reason, it is particularly important for the system to remain flexible and capable of an appropriate response, rather than to develop a fixed and programmed response to a situation to which it will be poorly adapted.

World oil demand is presently depressed, compared to what it might have been had earlier interruptions not taken place. If the demand for oil is now on the rise (as appears to be the case), our resilience in the face of a new interruption could diminish significantly. The relationship may not be linear, but the sign on the equation is surely correct. Delays in addressing this risk could prove to be costly.

The real risk in an oil interruption no longer appears to be of an embargo created by political retaliation against unpopular policies. Although politics will drive events, the more serious problem now appears to be one of physical damage to a critical installation or set of installations which process, refine, or load crude oil. Producing and consuming countries have learned much in the past ten years about the real costs of an oil embargo. While no one will venture to say that an embargo is impossible today, it appears to be generally agreed upon that it is at least improbable until existing production overcapacity disappears. It is not impossible, however, to imagine a deliberate attempt to remove critical oil-producing or oil-handling facilities from operation, as a result of military or paramilitary actions at the national or subnational level. Oil-handling facilities tend to be engineered uniquely, and missing or damaged parts can only rarely be ordered by telephone or replaced quickly. A sophisticated antagonist, aware of the vulnerability of a particular system, could shut it down for a long time.

The best will in the world will not bring that system back into operation, whatever the desires of the target country's policymakers, until the physical damage can be repaired. This makes possible the prospect of long and deep interruptions, and it is this prospect that is the most worrisome to oil experts.

Implications

The amount of oil which is affected more or less directly by the spot market is many times greater than it was in 1973 or even in 1979. The system is, to that extent and for that reason, more vulnerable than it has ever been before. In 1973, the spot market handled 3-5% of crude oil in international trade. By 1979, that figure had risen to perhaps 8% of international transactions. Today, informed observers estimate that 50-60% of crude oil is either traded on the spot market, linked in price to spot prices, or subject to short-term or interruptible contracts that have the effect of tying its price to current spot prices. While this has increased the volume of oil in the spot market, it also has had the effect of making the entire oil market much more volatile, and of making economies much less able to handle significant price increases through the incremental inertia of a large volume of low-cost oil. To that extent, we are all at risk.

There is a new factor in the equation, whose impacts cannot be easily anticipated—the oil futures market. Perturbations in the world oil market might well manifest themselves first in the futures market and then reverberate through the spot market. These actions could be quick and abrupt, leaving little time for discussion, deliberation and considered judgment. Once again, the time factor could be critical.

The threat to society is no longer one of an energy crisis—it is that of an *economic* crisis, triggered by a sharp increase in energy prices. The effects of a decrease in energy supply, while not inconsiderable, are dwarfed by comparison. No one has been able to calculate the precise costs imposed upon the world by the 1979 oil interruption. Economists and informed analysts accept that those effects were enormous. It is now generally recognized that these are the effects which we must be alert to avoid in the future—to the extent that we have any ability to avoid or minimize them.

Strategies for Response

Uncoordinated responses to another oil interruption could easily produce the kind of economic free-for-all that characterized the energy world in 1979-80. One major purpose in creating the IEA was to provide an arena in which the industrialized countries could meet to settle upon a measured response to energy emergencies. There has been considerable discussion among energy commentators about why things went wrong in 1979 and why they did not go wrong in 1980, given an interruption of similar magnitude. All agree that a major reason for the 1979 problems was that stockpiles were low and that the response of the system was poorly coordinated. It should also be pointed out that market conditions in 1980 had changed significantly: OPEC was no longer operating at or near capacity, demand was falling and stock-building had ceased.

Stock drawdown and demand restraint are different and potentially complementary ways of dealing with an interruption in oil supply. Countries tend to consider these strategies as alternatives, although it would make more sense for each to be used in ways for which they are best suited.

Quick action, following another serious oil interruption, may be necessary to prevent the kind of rapid escalation of prices that occurred in 1979. Stock drawdowns, perhaps only of small quantities, appear to be better suited to the need for prompt response than other strategies available to the energy-consuming nations. The options of demand restraint, increased indigenous production, or fuel-switching, could be too delayed in impact or too inconsequential in effect to prevent panic buying or to damp swings in the spot market.

While stock drawdowns can be effective early in an interruption, their value tends to decrease as the period of interruption lengthens. The principal value of stockpiles lies in their ability to buy time—time to accommodate to the new international energy situation, time to put long-term strategies into place without the price of oil having increased substantially in the interim. As time passes, however, these factors tend to diminish in importance, particularly so since the stockpiles themselves are diminishing in size. Add to this the fact that the value of a barrel of oil left in reserve tends to increase to the holder as the stock decreases, and the conclusion is irresistible that stock drawdowns are not strategies suited to a long disruption. Something else is needed.

Demand restraint is rarely an effective measure early in a disturbance—lags in time and other problems will inevitably delay its impact. Its importance increases as the length of the interruption goes on. Time lags *will* occur while the crisis is being identified, while the nature of the response is being debated, while the measures are being implemented, while they are taking effect, and while those effects are being measured. Political resistance to the imposition of effective demand restraint measures is likely to be high unless the event creating the need for such measures is absolutely unambiguous. Taken in the aggregate, these factors can produce delays of a half year or longer before governments can be certain what they had or had not been able to accomplish. In that intervening time, much can happen, and most of what happens is not likely to be beneficial. Further, establishing a baseline against which the effectiveness of a demand restraint system may be identified and justified is neither easy nor without controversy.

The value of an effective demand restraint system lies in its ability to allocate, either through government action or action of the marketplace, the use of energy within an economy in such a way as to minimize the damage that would otherwise occur. Correctly used, demand restraint measures can protect essential sectors within an economy over the time of a disturbance and that time need not be critical.

The largest part of IEA member country oil stocks is held in only a few countries. If they could agree among themselves to respond quickly to forestall a rapid and unnecessary increase in world oil prices, their action alone may be sufficient to accomplish this objective. While collective action among the OECD nations is an important and worthwhile goal, prompt action by the United States, Japan, Germany, Italy, and France, who together hold about 78% of the world's strategic oil reserves, might be enough to damp a rapid runup in the world price of crude oil. It might be difficult to sell the political proposition within these countries that, because of the size of their reserves, they have a special obligation to act. As a practical matter, however, concerted action by these few countries could serve to induce the rest of the OECD membership to draw down their own stocks.

Legal authorities already exist in most countries to deal with agreed-upon demand restraint or stock draw decisions in the event the IEA 7% trigger is drawn. In a subcrisis situation, however, many of those authorities are not now available to several governments. Events of the past few years indicate that the possibility of a subcrisis is more likely than that of a deeper interruption, and that its effects can be almost as damaging. Countries should be encouraged to examine their own laws with a view to determining whether additional authorities should be obtained to cover this eventuality.

Recommendations

The world economy was put under considerable stress in 1973 and 1979 by rapid changes in the price of crude oil. The kind of embargo that took place in 1973 seems unlikely to recur, but the economic chaos of 1979 and 1980 still seems to threaten the world economy. Essentially, two major changes appear to have taken place since 1979.

The first is that the 1979 upheaval did happen and that we may have learned better how to deal with a similar problem in the future. Whether or not we have really learned to do so will become clear only with time. The ability of governments to handle the situation and to prevent the ensuing economic upheavals has been seriously questioned in some circles, and this subject deserves closer consideration. It is certainly true that industry is far less likely to build stocks in the event of a disturbance if there appears to be any likelihood that they will be left with expensive and unnecessary inventories after the dust has settled.

The second major change is that the amount of oil in government and government-mandated inventories has increased considerably. The timing and manner of accessing those reserves has not yet been resolved, and it may not be possible or desirable to do so with precision. A decision to access reserve stocks involves a careful balancing of priorities—the need for flexibility must be weighed against an equally serious need for predictability.

Coupled with the increase in required stocks is, however, a very significant decrease in industry discretionary stocks. We know that primary oil stocks are low today—lower than they have been since 1974. And we know also that an important cause of the problems of 1974 and 1979 was the relatively low level of those stocks. For this reason, the existence and accessibility of government-held and mandated stocks assumes enormous significance.

In a more perfect world, the answer to the problem would seem transparent: increase the level of stocks that could be drawn quickly to meet the kind of sudden change in energy supply and demand that would follow upon a deep or prolonged interruption. Under EC and IEA rules, member countries are required to hold 90 days' worth of prior consumption or net imports. That 90-day margin may not present quite as much security as had originally been believed, both because not all countries have been successful in storing this amount and because the minimum operating levels required to operate a refining and distribution system for oil products cut deeply into that margin of safety. But in any case, the 90-day requirement is important and does serve a useful purpose.

Absent an agreement to use reserves early in a crisis, however, the mere existence of those reserves may not provide adequate reassurance of our ability to handle a sudden swing in world oil prices. Oil traders are sophisticated observers of economic and political events. Without a doubt, the existence of those stocks alone has to be a major factor in any decision to buy crude oil in the world market. How much more significant would it be if it were known that these reserves, or some part of them, could be quickly used in the event of a sudden upswing in oil prices?

Would it make sense to create a small reserve, in addition to those stocks which are now held, to be used quickly in the event of a major disturbance in the world oil market? It would. Is such a strategy likely to be followed in the foreseeable future? No, it is not. The expense of building and maintaining such a reserve appears today to render it, for all practical purposes and in most IEA countries, quite out of the question.

Industry and government observers are unanimous on this point. Most agree that such a reserve would be useful, but go on to say that the costs of such a system would be prohibitive and the likelihood that it could be accomplished in the foreseeable future is very small- all the more so because the world economy is so weak at present. The fact that this weakness is due in great part to the sudden step increases in oil prices in 1973 and 1979 has been lost on no one, but we have to deal with the world as it is, and not as we might wish it to be.

Another alternative which might be considered would be an agreement that some portion—not necessarily a large portion—of existing government held or mandated reserves might be designated as subject to expedited withdrawal, under well but not too rigidly defined circumstances. This would allow a relatively flexible response from a large body of nations; and a large reservoir of oil and would serve as a major inhibition on the tendency of the oil market to react quickly and negatively to an interruption. It would provide what amounts to breathing room, in such an event, to allow governments and industry to analyze events and to attempt to develop a reasoned strategy, which could well involve government-created demand restraint measures, to deal with them.

That breathing room could prove to be essential, since even if stocks are released in time to damp the first major price increases it will be necessary for discussions to be held and decisions to be made on ways to keep the system functioning smoothly. If, for example, government stocks are sold, officials may have to deal with constituents who have different ideas on what should be done with the proceeds of the sale, other than to wait a necessary interval and then use them to rebuild depleted inventories.

Could such a process be put in place without a major change in existing international agreements or treaties? We suspect so, but cannot be certain without more study of the question. Such a new policy would not come easily nor would it happen quickly. It is our understanding that the IEP would not stand in the way of an agreement to use stocks in this way, if the Governing Board of the IEA supported such an initiative. The European Community rules might require more formal action, and this subject needs to be explored more fully than we have been able to do in this study.

Some IEA countries have authority to draw down their stocks, assuming IEA approval, or to impose demand restraint measures before the IEP 7% trigger amount is ever drawn; others either lack this authority, or are not altogether clear on its existence. Nor is it certain, in all cases, whether the authority of the government runs so far as to require companies to draw upon their mandatory reserves, or if it merely would permit them to do so. We recognize that the difference may be mostly academic, since governments can be extraordinarily persuasive without direct authority, if they believe a compelling national interest requires that action. We believe that these matters can and should be clarified. If an emergency were to occur, valuable time might be lost while these judgments are being made and while the necessary authority is being obtained, if this proves to be necessary.

Given these circumstances, we recommend that the following steps be considered as further strategies for dealing with a possible oil interruption:

The industrialized nations should carefully weigh the costs and benefits of increasing their present levels of oil reserves to create a supply which could be easily and rapidly drawn upon in the event of a disturbance.

If this proves politically impossible, countries should consider designating a small part of their existing oil reserves as subject to early and expedited drawdown, in the appropriate case.

IEA nations should review their own laws and regulations to consider their adequacy in the event of a less than 7% interruption of oil. A "subcrisis" could be as dangerous to the world economy as one which would trigger the IEP. Authorities to permit or to require drawdown of oil stocks in such cases should be clarified, as well as authorities to impose demand restraint measures, where this is considered to be an appropriate role for government.

Emergency response programs, and particularly oil stockpiles, are created to protect a society against the social and economic devastation that would attend upon a major disturbance in the flow of crude oil. In this sense, they constitute a form of insurance—a hedge, so that if something unfortunate does happen, its consequences will be less destructive. The cost of this insurance is substantial, and there are many who feel that it is too great already, considering the other uses to which the funds could be put. But if we are correct in our analysis, the risks are also still very great, and it may well be that a slight increase in the resources committed to this insurance policy would significantly improve society's ability to ride out the storm that would follow another oil disruption.

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